



US STANDARD-TYPE BATTLESHIPS 1941-45 (1)

Nevada, Pennsylvania and New Mexico Classes



MARK STILLE

ILLUSTRATED BY PAUL WRIGHT

NEW VANGUARD 220

US STANDARD-TYPE BATTLESHIPS 1941–45 (1)

Nevada, Pennsylvania and New
Mexico Classes



MARK STILLE

ILLUSTRATED BY PAUL WRIGHT

CONTENTS

INTRODUCTION	4
• The Impact of Naval Treaties on USN Battleship Development	
AMERICAN BATTLESHIP DESIGN DEVELOPMENTS	6
• Interwar Reconstruction of American Battleships	
• American Battleship Weapons	
• USN Battleship Radar	
THE BATTLESHIP CLASSES	13
• Nevada Class	
• Pennsylvania Class	
• New Mexico Class	
ANALYSIS AND CONCLUSION	42
BIBLIOGRAPHY	46
INDEX	48

US STANDARD-TYPE BATTLESHIPS 1941–45 (1)

NEVADA, PENNSYLVANIA AND NEW MEXICO CLASSES

INTRODUCTION

The United States Navy (USN) went to war in December 1941 with 17 battleships in commission, which gave it the largest battle fleet in the world. The commissioning of the two North Carolina-class battleships in 1941 created the USN's first new battleships since 1923. These were the first of ten modern battleships that recorded productive and high-profile wartime careers. However, of the 17 battleships in service, 15 were older units, with the earliest dating back to 1912. These were still seen as the heart of the fleet and critical to the Navy's war plans. Though these ships did not play the central wartime role forecast by many of the Navy's admirals, they did have active careers and made real, and often overlooked, contributions to victory. This book covers the seven ships of the Nevada, Pennsylvania and New Mexico classes, which were the first "superdreadnoughts" in USN service. These ships were the first to combine the 14-inch gun with armor designed to protect the ships in long-range gunnery engagements. The five ships of the Tennessee and Colorado classes, together with the ships of the unfinished South Dakota class of battleships and the Lexington class of battlecruisers, will be covered in a separate title. A detailed treatment of USN battleship fire control and radar systems will also be included in the next part of this study on the USN's older battleships.

The Impact of Naval Treaties on USN Battleship Development

The dreadnought¹ building race going into World War I reflected the importance of these ships to the major naval powers. The battleship was both a political symbol and a measure of naval power. A nation that could produce such a complex and powerful weapon system was in the forefront of industrial and technological progress. The cost of battleships and their maintenance was prohibitive, meaning that only the wealthiest nations could afford more than a token one or two ships. The total number of battleships, acting as part of a balanced battle fleet, was the measure of a nation's naval strength. Coming out of World War I, the position of the battleship as the arbiter of naval power was unchallenged. In the aftermath of the war, Great Britain, Japan, and the United States all had plans for a major battleship-

¹ The term dreadnought is synonymous with battleship. It derives from the first all-big-gun battleship HMS *Dreadnought*, launched in 1906, which made all earlier "pre-dreadnought" battleships obsolete.

building spree. The ambitious USN plan would have moved it ahead of the British Royal Navy (RN) and greatly surpassed Japan's battle fleet.

None of the three naval powers was in a position to fully execute incredibly expensive building programs, so when the Americans proposed a naval disarmament conference to be convened in Washington at the end of 1921, the offer was accepted by all the major naval powers of the day. The resulting Washington Naval Treaty of February 8, 1922, contained a limit to overall battleship tonnage for each power (for the USN it was 525,000 tons, which gave it parity with the RN, but this was not actually achieved until 1931) and also set limits for the ships themselves. Each ship could be no larger than 35,000 tons and could not carry a main gun larger than 16 inches. The treaty was binding for 15 years. Because the USN was already over its allowable limit, it had to scrap older dreadnoughts and scrap or cancel new ships already begun or projected. With new battleship construction forbidden, the USN was forced to concentrate on modernizing existing units during the interwar period. The London Naval Treaty of 1930 kept the building limits in place until the system of naval arms control collapsed at the end of 1936.

The USN battle fleet had to be able to execute War Plan Orange, which was developed between the wars to handle a postulated war with Japan. Conflict with Japan was considered the most likely conflict scenario for the USN and was at the center of 1930s war planning. In short, Orange assumed a three-phase war. In the initial phase, Japan would overrun the Philippines and other US possessions in the western Pacific. The next phase centered around the dispatch of the US Pacific Fleet to conduct a series of island-hopping battles in the Japanese-held mandate islands in the central Pacific. The final phase included a decisive fleet battle, which would feature a clash of Imperial Japanese Navy (IJN) and USN dreadnoughts. The plan was underwritten by the strength of the USN's battle fleet, which would have to operate at unprecedented distances from its main base in Hawaii. As the USN's battle fleet moved into the central and western Pacific, it would have to contend with Japanese submarine and air attacks before eventually gaining the opportunity to engage the Japanese battle fleet. To prevail in this campaign, USN battleships had to have superior protection, long-range hitting power, a high level of protection against destroyer and aircraft attack, and great endurance.

Oklahoma leads two other battleships in March 1930 in a line ahead. The ships have their main batteries trained to starboard probably for a gunnery exercise. This was the epitome of naval power during the period, and USN strategy and tactics rested upon the power of its battleships.



AMERICAN BATTLESHIP DESIGN DEVELOPMENTS

The battleship was the most powerful ship of its era because of its balance of offensive and defensive strengths. The most obvious attribute of a battleship was its big guns, which gave it immense hitting power and range. This made it superior to all smaller ships. Most battleships were designed to include protection against a counterpart armed with weapons equivalent to those carried by the battleship itself. For example, American battleships armed with 14-inch guns were protected against the fire of an enemy ship equipped with 14-inch guns. This level of protection meant that only a battleship could sink another battleship unless the ship was placed in an unfavorable tactical situation where it could be threatened by torpedoes or mines. Of course, aircraft became the principal enemy of battleships during World War II, but when the USN designed its superdreadnoughts the advent of aircraft as a real threat against a heavily armored warship was not foreseen.

The USN built a large number of pre-dreadnoughts, but the advent of HMS *Dreadnought* in 1906, the world's first all-big-gun ship, made this fleet obsolete. The USN responded by embarking on a program of building dreadnoughts, beginning with the *South Carolina* (BB 26), which was commissioned in 1910. Up through 1914, the USN brought into service ten dreadnoughts in five classes. The four earliest classes were equipped with 12-inch guns, but the New York class, commissioned in 1914, jumped up to 14-inch guns. Of these early dreadnoughts, only three (*Arkansas*, *New York*, and *Texas*) were still in commission by the start of World War II. Two others, *Utah* and *Wyoming*, had been demilitarized under the terms of the London Naval Treaty of April 22, 1930, and had been converted to training ships. The other five dreadnoughts had been scrapped in accordance with the terms of the Washington Naval Treaty. The high costs of building dreadnoughts and the displacement restrictions of the naval treaties meant that each USN battleship design had to carefully weigh the requirements for firepower, speed, and protection and find an appropriate balance among the three. Generally, American designers emphasized firepower and then protection, with speed coming in a distinct third.

Beginning with the Nevada class, the USN produced a series of battleship classes that were remarkably alike. The basic features of these classes were a main battery in four turrets (as opposed to five or six turrets in previous classes), the "all or nothing" protection scheme, and a move to oil fuel (as opposed to mainly coal). The power of these ships compared to earlier dreadnoughts prompted naval observers to dub them superdreadnoughts.

The Nevada class introduced the concept of "all or nothing protection." This was a significant improvement over previous inefficient armor arrangements. Traditional armored protection schemes focused on a heavy main belt, since battle ranges were 10,000 yards or less. Engagements at this range meant that enemy shells would strike the ship at a

Oklahoma passing through the Panama Canal in October 1936. This view shows the improved placement of the secondary battery in casemates on the main deck and the location of the ship's catapults. Three aircraft could be carried as shown here.





nearly horizontal angle, making the main belt over the ship's vital areas key. This arrangement was no longer viable as engagement ranges were extended. Now shells could hit anywhere, not just on the side of the ship when limited battle ranges meant a low shell trajectory. Most likely, armor-piercing (AP) shells would be used against battleships, and these could only be defeated by increasing the thickness of armor over key areas. Areas that did not cover vital areas were left unarmored. This allowed the available weight of armor to be concentrated on the areas that mattered most. American practice focused on defeating AP rounds that could penetrate to the vitals of the ship. The effect of high-explosive rounds, which would burst on contact with even light armor and create great destruction topside but not penetrate to vital areas, was seen as a lesser danger. This concept was well ahead of its time and provided the best possible protection at long ranges.

In addition to plunging fire from other battleships, the interwar period saw the continued technological improvement of aircraft that had the potential of threatening the mighty battleship. Aircraft bombs would have to be dropped from fairly high altitudes to gain enough velocity to penetrate armored decks. The higher the altitude, the more time the maneuvering battleship had to evade the bomb, which made high-level bombing a very unpromising form of attack. The ineffectiveness of this form of attack was amply demonstrated during World War II. Dive-bombing was more accurate, but the relatively small bombs carried and the very low altitude from which the bombs were dropped meant that they did not possess the kinetic energy to penetrate the battleship's horizontal armor in order to hit its vital areas. Therefore, dive-bombing could cripple a battleship, but not sink it.

Beginning with the Nevada class, American battleship designers assumed greater battle ranges, and thus the need to provide more armor on the main deck was recognized. A separate splinter deck was provided below the main armor deck to catch splinters should a shell or bomb penetrate the main deck. These two armored decks provided over 8 inches of armor over key areas on the New Mexico class. This level of horizontal protection was superior to RN and IJN ships.

USN battleships achieved this level of armored protection by reducing the amount of the ship that needed to be protected. This was done by several means. The number of turrets was minimized, thus reducing the length of the vital area. This was achieved by adopting triple turrets, which gave a 12-gun

LEFT

All three New Mexico-class ships pictured together in Pearl Harbor in December 1943. From right to left are *Mississippi*, *New Mexico*, and *Idaho*. Because none of the ships underwent extensive modernization during the war, their appearances are still similar. However, subtle differences can be seen in the bridge structures and in their radar fits. All three ships are in the Measure 21 Navy Blue scheme.

RIGHT

The three ships of the New Mexico class shown together proceeding in column in January 1938. *Idaho* leads *Mississippi* and *New Mexico*. These were considered by the USN as its most powerful battleships, since they had the benefit of full modernizations before the war. When the Atlantic Fleet had to be reinforced in mid-1941, the New Mexico class was selected, and when King pressured Nimitz to commit the older battleships to combat in the South Pacific, these ships came the closest to seeing action.

An aerial view of *Pennsylvania* on May 31, 1934, following modernization. The modernization of all four ships of the Nevada and Pennsylvania classes gave them virtually identical appearances and capabilities.



broadside with only four turrets. A lower speed was also accepted, which reduced the need for larger machinery spaces.

Interwar Reconstruction of American Battleships

The Washington Naval Treaty precluded new battleship construction, so the USN was forced to upgrade the combat capabilities of its existing ships. The Nevada, Pennsylvania, and New Mexico classes were seen as deficient in several important measures, so the modernization work was a virtual reconstruction. The Washington Naval Treaty actually forbade reconstruction, so major work on the main belt or main battery was precluded, but there were still significant upgrades in firepower, protection, and propulsion.

All three classes were seen as negligent in underwater protection, so this was a top priority. All were blistered, which meant that the explosion of a torpedo or mine would occur at a stand-off distance from the hull, thus minimizing damage. However, the addition of the blister greatly increased the ships' drag, potentially affecting speed. The horizontal protection of the ships against long-range plunging fire was also improved. Typically, the 3-inch armor deck was increased to between 4¾ and 5 inches.

Firepower was improved by increasing the maximum gun elevations, which gave longer ranges. This was accomplished in spite of a treaty clause that specifically banned such an improvement. Elevation for USN main

This aerial view of *Idaho's* starboard bow was taken in January 1938 and shows the post-modernization configuration of the *New Mexico* ships. The ship presents a powerful and graceful appearance with its clipper bow, large bridge structure, and four triple 14-inch turrets.





A fine starboard-beam view of *Mississippi* following her modernization. The ship can be easily identified from earlier USN dreadnoughts by her larger bridge structure and clipper bow.

battleship guns was doubled to 30 degrees. New fire-control systems were added to the Nevada and Pennsylvania classes on large tripod masts. The USN considered that any engagement beyond 20,000 yards would have to be aided by spotting from aircraft, so provisions were made to fit catapults on all battleships in order that aircraft could be carried. The usual configuration was one catapult fitted on the quarterdeck and another on the top of the superfiring aft turret.

The secondary battery was moved from its hull casemates to the deckhouse, where it could be operated in all weather conditions. Antiaircraft protection was dramatically upgraded, with eight 5-inch/25 (meaning the gun was 25 times longer than its caliber) dual-purpose weapons being fitted. The fire-control systems for the main, secondary, and antiaircraft batteries were moved to two large masts called “control tops” on the Nevada and Pennsylvania classes and on top of the large superstructure added to the New Mexico class.

The propulsion system was upgraded using the machinery from the canceled South Dakota class of six battleships which were laid down in 1920, but canceled in 1922–23 to meet the restrictions of the Washington Naval Treaty. This extra power was sufficient to negate the resistance from the massive bulges. Even so, speed was still an issue, with the Nevada, Pennsylvania, and New Mexico classes not exceeding 21 knots. This made them inferior to RN battleships, and more importantly, Japanese battleships. The New Mexico class received the most extensive modernizations, which will be described later.

American Battleship Weapons

The three classes covered in this book all carried a 14-inch gun main battery. The USN’s jump from 12-inch guns on its earliest dreadnought classes to 14-inch guns was forced by the adoption of a 13½-inch weapon by the RN and the 14-inch gun by the IJN. Adoption of the larger weapon placed the survival of previous 12-inch-gun-equipped ships at risk, since they were not armored against such a threat. The new gun meant that all battleships would

The forward 14-inch turret aboard *Nevada* trained to starboard and preparing to fire on targets on Iwo Jima in February 1945. The 14-inch/45 gun was a dependable and formidable weapon that could fire a 1,500-pound armor-piercing shell a maximum of 34,300 yards or a 1,275-pound high-explosive shell to 34,700 yards. The effect of a 14-inch shell against land targets, even ones that were highly fortified, was highly destructive, which made older USN battleship very effective gunfire support platforms.



have to be heavier to provide the weight of protection necessary to defeat a 14-inch gun. The Nevada and Pennsylvania classes carried the 14-inch/45 gun and the New Mexico class carried the 14-inch/50 weapon. The longer the gun, the longer the period of acceleration, so the higher the velocity. Higher velocity increased penetration, but also increased the wear on the barrel.

Adoption of triple 14-inch turrets helped to reduce weight and avoided the inefficient placement of the main battery in previous classes. This decision to go to a triple turret was made before the design for a triple turret existed, so this was a decision with some risk. When introduced, the turret was successful. An initial problem with salvo dispersion was addressed by introducing a short interval between the firings of the three barrels in the turret. The triple turret on the Nevada class came in at 748 tons, while those on the Pennsylvania class weighed between 714 and 725 tons. Both had a firing cycle of some 50 seconds. The New Mexico class introduced a new triple turret with the guns in separate slides, which reduced the risk that all three guns could be knocked out by a single well-placed enemy shell. This new turret weighed 958 tons and had a firing cycle of 45 seconds.

The provision of a powerful secondary battery was an important design consideration on USN dreadnoughts. Destroyers were a real threat to battleships, since the torpedoes they carried could defeat the underwater protection of most such ships. The Americans believed that secondary battery guns had a longer range than Japanese torpedoes (the development of the Japanese oxygen-propelled Type 93 torpedo with its maximum range of 43,700 yards was undreamed of), so a powerful secondary battery offered the best defense against torpedo attack. The assumed greater range of guns over torpedoes made it likely that enemy destroyers could attack at night,

LEFT

All USN prewar battleships (except the just-completed North Carolina class) went to war with the 5-inch/25 high-angle gun as their primary antiaircraft weapon. This gun was capable of a high rate of fire in the hands of a well-drilled crew, but it suffered from a relatively short range.

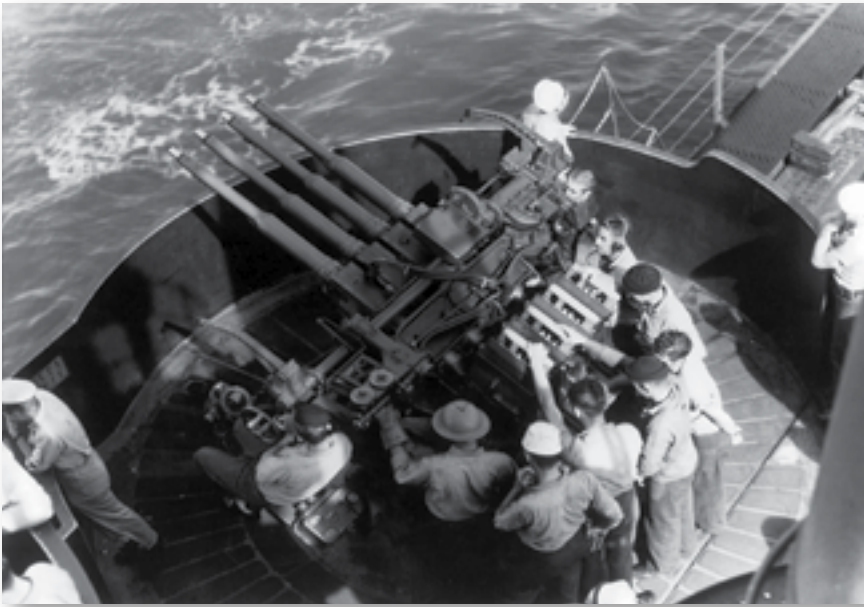
RIGHT

This picture was taken on October 20, 1944, and shows the four starboard 5-inch/38 twin mounts aboard *Pennsylvania* shelling targets on Leyte. The 5-inch/38 gun was the best dual-purpose weapon of the war, with a high rate of fire and excellent accuracy. It was intended that all USN battleships be fitted with this weapon, but only those ships damaged at Pearl Harbor and forced into long repair periods had the opportunity to receive them.

USN Battleship Main and Secondary Guns

Type	Muzzle Velocity (ft/sec)	Max Range (yards)	Rate of fire
14-inch/45	2,700	23,000	1–2 rds/min
14-inch/45 (post-modernization)	2,700	34,300	1–2 rds/min
14-inch/50	2,700	36,600	1–2 rds/min
5-inch/51	3,150	15,850	8–9 rds/min
5-inch/25	2,110	14,500	14 rds/min
5-inch/38	2,600	18,200	15–20 rds/min





The 1.1-inch quad mount was planned to augment the anti-aircraft fit of all USN battleships prior to the Pacific War. It finally reached the fleet in early 1942, but was plagued by jamming problems and heavy maintenance requirements. It was replaced as soon as possible by the much more effective 40mm quad mount.

and thus the inclusion of powerful searchlights was also an important battleship design feature.

American battleships went to war with an inadequate level of anti-aircraft protection, as demonstrated by the experiences of the RN in Europe. The King Board (named after its chairman Admiral Ernest King) of 1940–41 called for each battleship to be armed with eight twin 5-inch/38 mounts, four 40mm quadruple mounts and eight 20mm single mounts. This was not possible to achieve before the war due to production problems and the impossibility of pulling ships out of service for lengthy refits. The interim solution was the addition of four 1.1-inch quadruple machine cannons. Even this proved impossible since there were also shortages of that weapon, so 3-inch/50 anti-aircraft guns were allocated instead.

The standard prewar 5-inch/25 gun was a respectable weapon with a high rate of fire, but possessed reduced range and accuracy. The more modern 5-inch/38 gun was superior and was the best dual-purpose naval weapon of the war, but only three of the seven ships covered in this book ever received them.

USN battleships were also deficient in short- and medium-range anti-aircraft weapons at the start of the war. The eight .50-caliber machine guns fitted prewar were intended to defeat dive-bomber attacks but were clearly insufficient for this purpose. The 1.1-inch quad mount just coming into service proved to be unreliable and lacked range. These were replaced as quickly as possible with the 40mm Bofors gun, usually in quad mounts but also by limited numbers of twin mounts. The 40mm quad mount proved very effective in service. Fire control was provided by the Mark 51 director and the weapon proved effective out to about 3,000 yards. The standard short-range anti-aircraft weapon from 1942 was the Swiss-designed 20mm Oerlikon gun. This weapon was air-cooled, required no external power source, and was comparatively lightweight, so it could be fitted in large numbers aboard big ships like battleships. It was originally fitted as only a single mount, but late in the war a twin mount was provided to increase firepower in the face of the kamikaze threat. The 20mm was a last-ditch weapon, only effective to about 1,500 yards.

Quad and twin 40mm mounts on *New Mexico* in June 1944. The 40mm Bofors gun was fitted to all older USN battleships, beginning in late 1942. The gun proved very successful in service and was the best intermediate-range antiaircraft gun of the war. The weapon was effective out to about 3,000 yards. Fire control was provided by the Mark 51 director.



A group of 20mm single mounts on *Idaho* in May 1945 with their Marine gunners. The 20mm was a useful weapon with its high rate of fire, and large numbers were fitted on all battleships. The weapon had an effective range of about 1,500 yards, which was useful against conventional air attack, but against suicide aircraft attack it was quickly found that the 20mm shell was not large enough to knock down a kamikaze before it hit the ship.

USN Battleship Antiaircraft Guns			
Type	Muzzle Velocity (ft/sec)	Max Range (yards)	Rate of fire (theoretical)
.50-inch Browning M2 water-cooled machine gun	2,930	7,400	550–700 rds/min
1.1-inch Mk 1/1	2,700	7,400	140 rds/min
20mm Oerlikon	2,740	4,800	450 rds/min
40mm Bofors	2,890	11,000	160 rds/min
3-inch/50	2,700	14,590	15–20 rds/min



USN Battleship Radar
Radar gave USN battleships a critical advantage against the Japanese in both surface gunnery engagements and in detecting and engaging aerial targets. The first radar fitted aboard a battleship was the experimental CXAM radar, which had a large mattress antenna usually mounted on the foremast. This set had a theoretical maximum detection range of 16nm against large surface targets and 70nm against large aircraft at 10,000 feet. In 1942, this was replaced by the SC radar. This set unsuccessfully tried to combine the CXAM's electronics with a smaller antenna. The improved SC-1 was more successful, since its greater power translated into almost twice the range compared to the SC.

The SC/SC-1 was replaced by the much more powerful SK air-search radar in all surviving older battleships by 1943. This could detect a large target at up to 100nm flying at 10,000 feet. Late in the war, *Pennsylvania* received the complementary SP radar, which had a 50nm maximum range against a large, high-flying target, but provided fairly good elevation accuracy. It was thus critical for guiding fighters against kamikazes.

The mainstay surface search radar was the SG. This was the first microwave radar to incorporate a display, which made interpretation much easier. Battleships first received this radar in early 1942, and the improved SG-1 entered service in May 1943. Battleships often received two SG radars, one each on the foremast and the mainmast. Range was 22nm against a large surface target.

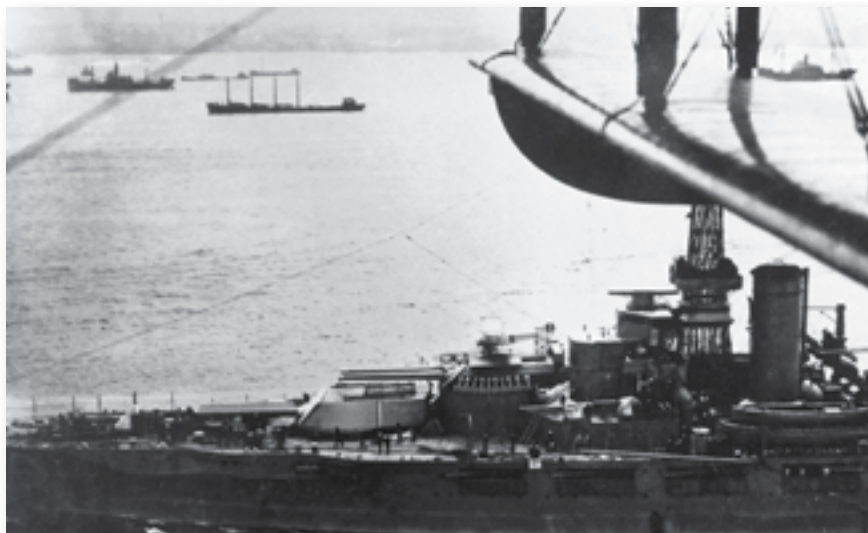
THE BATTLESHIP CLASSES

Nevada Class

Design and Construction

These ships represented the second generation of American dreadnought design. They featured a heavy 14-inch gun main battery, which made them the contemporary of ships being built by the RN known as superdreadnoughts. The most important design innovation of the class was the adoption of the “all or nothing” protection scheme. Initially, the USN looked at simply upgrading the previous New York class, but the scope of the desired improvements in protection made this impossible. The two ships of the Nevada class, *Nevada* (BB 36) and *Oklahoma* (BB 37) were authorized in March 1911. Work began in late 1912. Construction was planned to take three years, but in fact took longer, with *Nevada* entering service in March 1916 and *Oklahoma* two months later.

When completed, the ships presented a balanced and powerful appearance, with two main turrets forward and aft, a small bridge structure, two large cagemasts, and a single stack. The flush deck design feature was not used, instead replaced by the extension of the forecastle over 60 percent of the ship's length.



This view from 1920 shows one of the earliest additions to *Nevada* in the form of a short aircraft platform on top of Turret 2. This proved too dangerous to operate aircraft and was soon removed. Note the austere bridgework and the armored conning tower behind the aircraft platform from which the ship was controlled during battle.



LEFT

This April 27, 1925, view shows *Nevada* in fighting trim with her four main turrets trained to starboard. The most prominent feature of USN battleships during this period was their cagemasts. The USN preferred these to the tripod masts of other navies, since it was believed they were more resistant to damage as enemy shells could pass through the structure without bringing it down.

RIGHT

Oklahoma under way on January 15, 1916. The ship is on builder's trials before being handed over to the Navy in March. Though close to completion, the ship presents a very austere appearance, typical of the USN battleships of the period.

Nevada Class Construction

Ship	Built at	Laid down	Launched	Commissioned
<i>Nevada</i>	Fore River	Oct 4, 1912	Jul 11, 1914	Mar 11, 1916
<i>Oklahoma</i>	NY Shipbuilding	Oct 26, 1912	Mar 23, 1914	May 2, 1916

Protection

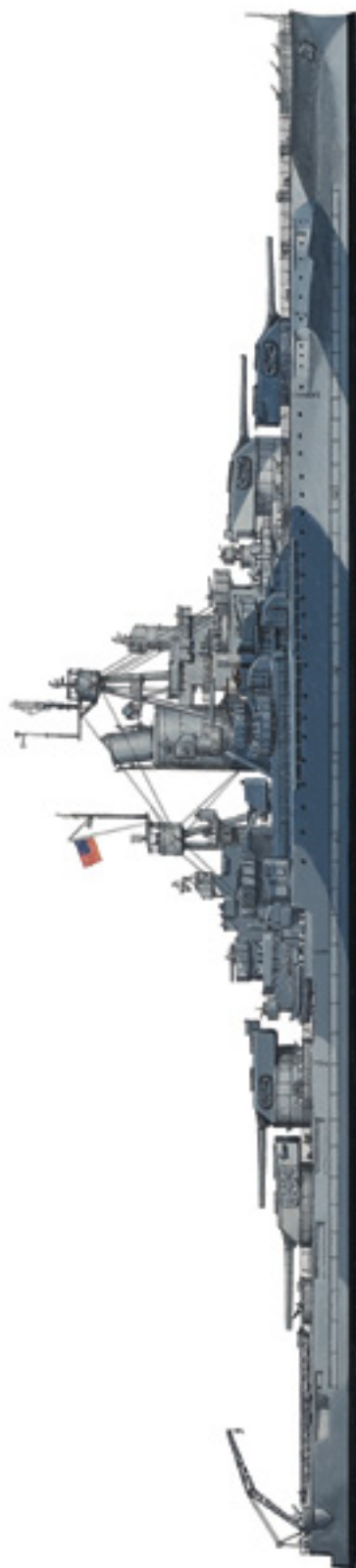
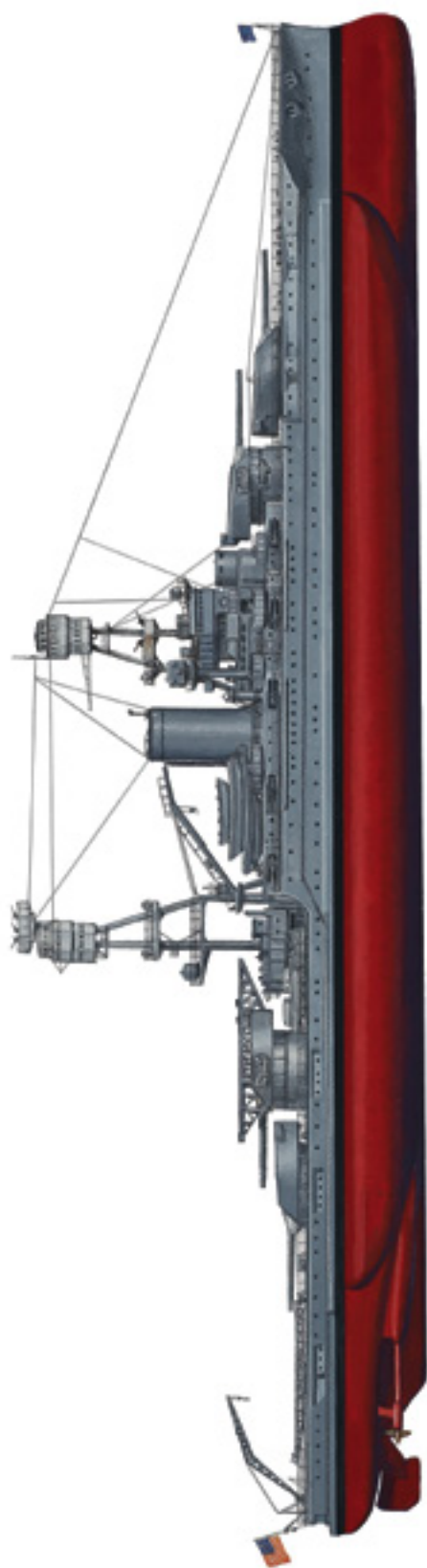
Adoption of the “all or nothing” concept resulted in a much more effectively protected ship. Compared to its European and Japanese counterparts of 1916, the Nevada class performed favorably, particularly in terms of horizontal protection. Of the ship's waterline length of 575 feet, only 400 feet was protected. This allowed a much greater emphasis on deck protection. Total weight of armor was 11,162 tons, of which only 3,788 was allocated to the main belt. The armored deck and the splinter deck had a combined 3,291 tons. Overall, armor was 40 percent of the design displacement.

The main armor belt was a maximum of 13½ inches thick for 9½ feet of the total 17 feet 4 inches of the total hull coverage of the belt. Almost half of the main belt was below the waterline, which tapered to 8 inches at its lowest point. The armored citadel was completed forward and aft by armored bulkheads with a maximum armor thickness of 13 inches. The turret barbettes received 13 inches of armor, the conning tower 16 inches, and the turret faces 18 inches. Horizontal protection totaled 3 inches of armor in three different layers that extended over the same length as the main belt. Underwater protection was minimal and was soon seen as a major weakness.

A

THE NEVADA CLASS

The top profile depicts *Oklahoma* as she appeared in December 1941 when she was sunk at Pearl Harbor. Not apparent in this view are the twin 14-inch superfiring turrets, which were the best way to distinguish her from later classes. The ship's profile is dominated by her two large control tops. *Oklahoma* is wearing a Measure 5 Painted Bow Wave camouflage scheme. The lower profile shows *Nevada* as she appeared in 1945 after she returned to the Pacific. The ship is in the Measure 31A/6B scheme. *Nevada* presents a dramatically different appearance from 1941. The ship is bristling with anti-aircraft guns, including the four 5-inch/38 mounts visible, and a robust electronics suite. The bridge structure has been modified and the unique stack configuration is apparent.





Oklahoma in Guantanamo Bay, Cuba in January 1920. This naval base at Guantanamo was heavily used as a training and exercise facility by the USN because of the year-round good weather.

rooms reduced the amount of the ship to be protected. *Nevada* was the first battleship to go all-oil.

Propulsion

Previous USN battleships relied on coal with a supplement of oil. The advantages of going to an all-oil arrangement were considerable, and included the facts that oil took less space, had a greater thermal content and would thus offer a greater radius for the same amount of fuel, made replenishment at sea possible, and dispensed with the issue of dealing with coal dust on sensitive equipment. Oil-fired ships required smaller boiler rooms, which also meant that the number of boiler room personnel could be drastically reduced. The smaller boiler

Nevada Class Specifications (as built)

Displacement	Dimensions	Speed	Range	Crew
27,500 tons standard; 28,400 tons full load	Length 583ft overall; Beam 95ft; Draft 28½ft	20½kt	8,000 miles at 10kt	864

Both ships were fitted with 12 boilers. *Nevada* was powered by Curtis direct-drive turbines and *Oklahoma* by reciprocating engines of the type fitted on previous USN battleships. This machinery generated 25,500 shaft horsepower (shp) on *Nevada* and 24,800 indicated horsepower on *Oklahoma*. This was adequate for just over 20 knots on both ships, clearly inferior to foreign counterparts. Each ship required only a single stack to vent the exhaust from the compact machinery spaces.

Armament

The arrangement of the main battery was unique to this class. To mount the same ten 14-inch guns as on the preceding New York class, it was decided to use triple gun turrets for the first time. *Nevada* used two of these, one fore and one aft, combined with a dual turret fitted in a superfiring position to provide the ten-gun 14-inch broadside. The secondary battery of 21 5-inch/51 guns was mounted in hull casemates, but in an effort to improve their usefulness in moderate or heavy seas, 14 of them were mounted one deck higher than on preceding battleship designs. Two submerged 21-inch torpedo tubes were also fitted. These proved totally useless in practice, and having an unprotected explosive source down low in the hull was also a vulnerability. All USN battleships had their submerged torpedo tubes removed during their major reconstruction.

Service Modifications

Immediately after completion in 1917–18, both ships had the size of their

bridge structure enlarged. To assist in routine navigation, a small bridge was built abaft the armored conning tower that was suited to and designed for navigating and fighting the ship in battle. The secondary battery was reduced from 21 to 12 5-inch guns, and two 3-inch guns were added for antiaircraft protection. In 1920, flying-off platforms were added on the two superfiring 14-inch turrets. These were replaced by a catapult placed aft on the quarterdeck in 1922. By 1925, the 3-inch antiaircraft battery was increased to eight guns.

As has already been mentioned, USN battleships underwent extensive modernization during the interwar period. For the Nevada class this took place from 1927 to 1929. Both ships lost their cagemasts in favor of heavy tripod masts, and the bridge structure was substantially enlarged to handle the increasingly numerous and complicated equipment required for a modern fighting ship. Two catapults were added, one on the aft twin 14-inch turret and the other on the quarterdeck aft. Antitorpedo bulges were added, which increased the depth of torpedo protection to 22 feet. In addition, the boiler rooms were provided with torpedo bulkheads and a triple bottom was also incorporated. The upper armored deck was increased to 5 inches and parts of the lower armored deck increased to as much as 3 inches. All told, an extra 1,906 tons of armor were added.

Both ships also had six new boilers installed, and *Nevada* had her reciprocating engines replaced by new geared turbines from the canceled battleship *North Dakota*. This kept her speed at 20½ knots, but the addition of the bulges on *Oklahoma* with no new machinery reduced her speed to 19.7 knots. In addition to providing the main guns with increased elevation, all casemate 5-inch guns were moved one deck up. The 3-inch guns were replaced by 5-inch/25 high-angle guns. A light antiaircraft capability was added in the form of eight .50-caliber machine guns on the fighting tops of the new tripod masts. New catapults replaced the older ones but remained in the same locations. When completed, the ships displaced 30,500 tons.

In 1935 and 1936, both ships had the height of their stacks increased. Going into World War II, additional efforts were made to increase the ships' antiaircraft protection. In her February 1941 refit, *Oklahoma* was earmarked to receive four 1.1-inch quad machine cannons, but since these were not available, four 3-inch/50 guns were fitted instead. All eight

LEFT

This 1935 view of *Nevada* shows her after an extensive modernization. Note the larger forward superstructure and the elimination of the casemates along the hull. One of the most obvious differences is the replacement of the cagemasts with what were called "control tops." Each contained main and secondary battery directors and an air defense station, so if one was put out of action, the other could continue to direct the ship's weapons.

RIGHT

Oklahoma in September 1930 after the completion of her modernization. The prominent piece of equipment on top of the bridge is the primary rangefinder for the main battery. A back-up rangefinder can be seen on top of Turret 2.





Nevada pictured on July 1, 1943, off San Francisco shortly after the completion of her modernization. This work was not as extensive as on those battleships more heavily damaged at Pearl Harbor, but it has still transformed the ship's appearance. The aft tower mast has been removed, but the forward one remains. The most obvious new weaponry is the four twin 5-inch/38 mounts on each side. The single stack has been lengthened, giving her a unique recognition feature.

5-inch/25 guns received splinter protection. The four 36-inch searchlights were moved from the stack to the mainmast to get them higher up.

Nevada was the first of the severely damaged battleships at Pearl Harbor to be refitted and became a general template for the other five wartime reconstructions. The ship was refloated on February 12, 1942, departed for Puget Sound Naval Shipyard on April 22, and underwent modernization that took until December. The refit was done in minimal time and with minimal cost. A new superstructure was fitted, and the raked extension of the stack added to keep smoke clear of the bridge. The existing secondary and antiaircraft batteries were removed, and a new dual-purpose battery of 16 5-inch/38 guns in eight twin mounts was installed. These were controlled by four Mk 37 directors. Ten 40mm quad mounts and 38 single 20mm mounts were also added. To compensate for all this new top weight, the mainmast was removed and replaced by a stump mast. The armored conning tower, the catapult on the aft turret, 300 tons of fuel oil, 200 tons of reserve feed water, and a number of main battery rounds were all removed as compensation for the increased top weight.

Efforts to improve the ship's antiaircraft fit continued during the war. *Nevada*'s final fit in August 1945 was 16 5-inch/38 guns, ten 40mm quad mounts, 20 twin and five single 20mm mounts.

Wartime Modifications to Nevada-Class Battleships						
	5-inch/51	5-inch/25	5-inch/38	40mm	1.1-inch/3-inch	20mm
<i>Nevada</i> and <i>Oklahoma</i> (12/41)	12	8	0	0	4	0
<i>Nevada</i> (12/42)	0	0	16	40	0	38
<i>Nevada</i> (8/45)	0	0	16	40	0	45

Wartime Service

Nevada briefly served with the RN at the end of World War I. After modernization between September 1927 and November 1930, she was transferred to the Pacific Fleet. She was one of the eight battleships caught in Pearl Harbor on December 7, 1941. Of the eight, she was the only one to get under way during the attack. In the first wave, Japanese torpedo



bombers hit the ship with one torpedo. By the time the second wave composed of dive-bombers reached the area around Ford Island, *Nevada* was moving slowly to the channel to escape the harbor. The Japanese seized on the opportunity to attack the ship and sink her in the middle of the channel. Five 550-pound bombs hit the ship; one ignited the gasoline storage, which caused a massive fire. The fire threatened the forward magazine, so as a precaution it was flooded. The acting captain was ordered to beach the ship. Casualties amounted to 50 dead and 109 wounded.

Repairs and modernization took until December 1942. *Nevada* returned to combat in May 1943 for the invasion of Attu Island in the Aleutians. Following another refit, she joined the Atlantic Fleet with the oldest battleships in the USN (*New York*, *Arkansas*, and *Texas*). Her initial assignment in the Atlantic was to escort troop convoys, but in April 1944 she arrived in Great Britain for the impending invasion of northern France. For the Normandy invasion, *Nevada* was assigned to Force U, which was responsible for executing the landing on Utah beach. *Nevada* was very active on June 6, 1944, firing a total of 377 14-inch shells and 2,693 5-inch rounds. She remained on station off Normandy until June 17, gaining a reputation for providing consistently excellent gunfire support, and was then included in a naval demonstration off Cherbourg in an attempt to hasten the fall of that key port. The duel with the German shore batteries on June 25 found *Nevada* bracketed by accurate German shore battery fire, but undamaged. The duel ended in a draw. *Nevada* was then moved into the Mediterranean to take part in the August landings in southern France against generally weak opposition. Between August 15 and 24, *Nevada* engaged several targets before German resistance ceased. With no further need for battleships in the European theater, *Nevada* prepared to join the Pacific Fleet for the final drive to Japan.

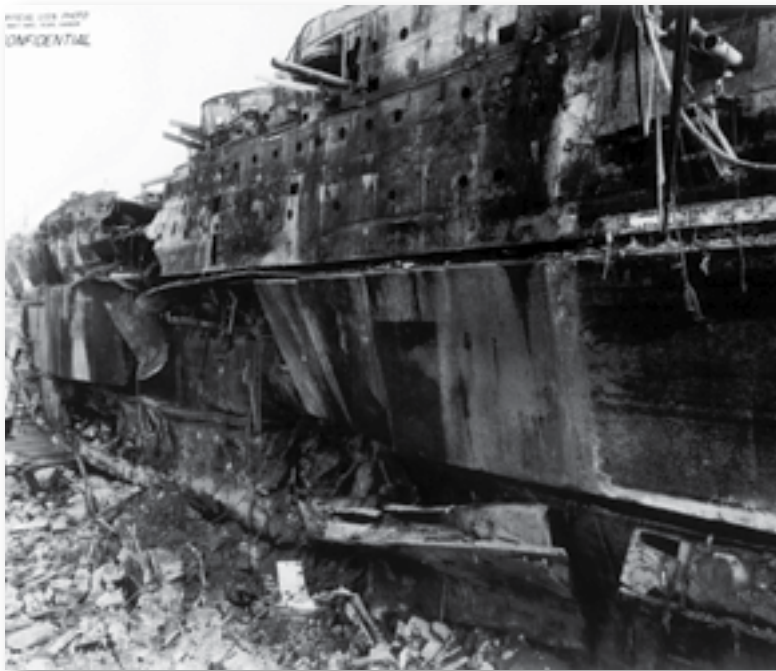
Her first operation back in the Pacific was as part of the invasion of Iwo Jima from February 16 to March 8, 1945. Following this, she joined the pre-invasion bombardment force off Okinawa on March 24. Three days later, she was struck by a single kamikaze in the area of Turret 3. Damage was slight, but 11 men were killed and 49 wounded. The damage did not cause her to leave station. On April 5, she came under fire from shore batteries and was hit by five medium-caliber shells, but damage was again

LEFT

Nevada pictured on February 6, 1945, in her last configuration. The two aircraft on the quarterdeck are OS2U Kingfishers, which were standard battleship-spotting aircraft during the war. The large radar on the foremast is an SK. The ship is bristling with anti-aircraft guns, from the prominent 5-inch/38 twin mounts to smaller 40mm and 20mm guns. Much of the detail is difficult to see because of the dark Measure 31A/6B camouflage scheme.

RIGHT

Taken from *New Mexico*, this March 27, 1945 photo shows the moment of impact of a kamikaze on *Nevada*. This occurred as she was supporting the preliminary bombardment of Japanese positions on Okinawa. The kamikaze was already hit and on fire before it crashed into *Nevada* on her main deck aft. The hit temporarily disabled Turret 3, destroyed three 20mm gun mounts, and wiped out both of the ship's Kingfisher aircraft while killing 11 and wounding 49. Despite the carnage, *Nevada* was able to stay on station.



The hull of *Oklahoma* in February 1944 after she had been finally refloated and moved into a dry dock. The effect of the impact of the Japanese torpedoes is dramatic. The hull was later sold for scrap, but when it was attempted to tow her to the west coast, she capsized about 550 miles out of Oahu.

slight (although another two men were killed and 17 wounded), and *Nevada* was able to remain off Okinawa until June 30.

Following the war, the battleship was ordered to Bikini Atoll for use in the two atomic tests against naval targets. The aging battleship survived these, despite being in the bull's-eye for the first test on July 1, and was brought to Pearl Harbor and was decommissioned in August 1946. On July 31, 1948, she was expended as a target off Hawaii and was sunk by gunfire from battleship *Iowa* and several cruisers, as well as ordnance from aircraft.

Oklahoma was also present in Pearl Harbor on December 7, 1941. Since she was one of two battleships moored directly in the path of the 24 Japanese torpedo bombers with the main target of Battleship Row, *Oklahoma* took the brunt of the attack. In an attack lasting 11 minutes, aircraft from three Japanese carriers launched 12 torpedoes at *Oklahoma*, and at least five hit their target. The first three hits came in quick succession and caused an immediate list to port. Within 15 minutes, the ship capsized and despite an early call to abandon ship, personnel losses were heavy. Of the crew of 1,354, 415 were killed and 32 wounded. Thirty-two men were extricated from her overturned hull in the following days. The massive damage to the ship and her capsized condition made her difficult to salvage. Work did not begin until March 1943, and the hull was not raised until December that year. At this point, it was decided to cease efforts to return her to service and the ship was stripped of useful equipment; the 14-inch gun barrels were later used on *Pennsylvania*. In December 1946, the hull was sold for scrap and was towed from Hawaii beginning on May 10, 1947. The ship never reached the United States, since she sank on May 17 after the tow parted in bad weather.

B

USS NEVADA

On June 25, 1944, *Nevada*, two other USN battleships (*Texas* and *Arkansas*) and a mixed force of four USN and RN cruisers was ordered to support the land assault on the fortress of Cherbourg on the Cotentin Peninsula. This key port was heavily defended by German coastal defense batteries, including Batterie Hamburg with four 9.4-inch/40 guns that were taken from Austro-Hungarian armored cruisers from World War I. From a range of 14,000 yards, a prolonged gun duel began. *Nevada's* log indicated that the ship was under fire for almost 3½ hours, during which German salvos straddled the battleship on 23 occasions and large shells came as close as 25 yards. On two occasions, German shells passed through the superstructure without exploding. Batterie Hamburg succeeded in hitting *Texas* on her bridge, but *Nevada* was unscathed. The duel ended in a draw, but Cherbourg surrendered three days later.



Pennsylvania pictured before the beginning of her modernization period in June 1929. Note the cagemasts and the large ship's boats amidships.

Pennsylvania Class Design and Construction



After the funding was granted for the Nevada class, the Navy requested four ships for the next battleship class, but this ran into Congressional opposition. A compromise between the House and the Senate resulted in a single ship being authorized in August 1912. This was *Pennsylvania* (BB38). The second ship of the class, *Arizona* (BB39) was only authorized in March 1913, to an almost identical design.

Consideration was given to making these two ships a repeat of the Nevada class, but it was decided to implement incremental improvements. The primary difference was a requirement to fit 12 14-inch guns. This and some improvements in protection required a slightly longer hull. Construction proceeded efficiently, and both ships were launched in 1916. *Pennsylvania* was fitted as the fleet flagship and could be distinguished from her sister ship by her higher conning tower.

This 1927 view of *Pennsylvania* shows some of her pre-modernization features, including cagemasts, a single catapult aft, two 3-inch guns atop Turret 3, and a 12-foot rangefinder atop the charthouse and Turret 3.

Pennsylvania-Class Construction

Ship	Built at	Laid down	Launched	Commissioned
<i>Pennsylvania</i>	Newport News	Oct 27, 1913	Mar 16, 1915	Jun 12, 1916
<i>Arizona</i>	NY Shipbuilding	Mar 16, 1914	Jun 19, 1915	Oct 17, 1916



Protection

The Pennsylvania class enjoyed the same general level of main belt protection as the preceding Nevada class, but the new class introduced changes in underwater protection. The main armor belt was 444 feet long and 17½ feet wide. Maximum thickness was 13½ inches, which tapered down to 8 inches on the lower edge. Half of the main belt was below the waterline. The armored bulkheads had a maximum thickness of 13 inches. The turret barbettes received 13 inches of armor, the conning tower 18 inches and the turret faces 18 inches.

Horizontal protection was increased with the provision of a lower armored deck. The uppermost armored deck remained at 3 inches arranged in three layers, but the lower armored deck added another 1½–2 inches arranged in two layers. Protection over the steering machinery was increased to 6¼ inches on the upper deck. The vulnerable boiler room uptakes were provided with 15 inches of armor protection. Since underwater protection was already seen as a potentially critical weakness on the *Nevada* ships, this was addressed in the new class. A 3-inch torpedo bulkhead 9½ feet inboard from the outer hull was fitted with a width of almost 12 feet. It was calculated that it could withstand an explosion of 300 pounds of TNT. Overall, protection was superior to RN dreadnoughts of the day, and equivalent to German designs.

Propulsion

Both ships were fitted with 12 Babcock and Wilcox boilers in three separate spaces. These drove a four-shaft turbine arrangement and generated 31,500shp on *Pennsylvania* and 34,000shp on *Arizona*. This produced 21 knots on both ships, still slower than foreign contemporaries. A single stack was used to vent the exhausts.

Pennsylvania-Class Specifications (as built)				
Displacement	Dimensions	Speed	Range	Crew
31,400 tons standard; 32,567 tons full load	Length 608ft overall; Beam 97ft; Draft 28 4/5ft	21kt	8,000 miles at 10kt	915 (this increased to 1,574 during World War II)

Armament

The success of the triple 14-inch turret allowed an increase to 12 14-inch guns fitted into four triple turrets. The secondary battery totaled 22 5-inch/51 single guns, almost all in casemates. For the first time, antiaircraft protection was included in the design in the form of four 3-inch guns. The two 21-inch submerged torpedo tubes were also fitted when the ship was completed.

Arizona pictured from her starboard beam in August 1935. Another prominent feature of USN battleships of the period was the large cranes positioned aft. These were used to service the catapult on top of Turret 3 and maneuver the ship's boats in and out of the water.



Service Modifications

After World War I, the secondary battery was reduced by eight guns with the removal of the four foremost and the four aftermost casemate guns. In July 1919, flying-off platforms were placed on the two super-firing 14-inch turrets, which required the removal of two of the 3-inch guns. In 1921, the 3-inch gun suite was increased to eight guns and two more 5-inch/51 guns were removed.

The major modernization began in 1929. Both ships received new boilers and turbines, but speed was not increased since the modernization added some 3,100 tons of weight. Protection was enhanced, with another layer placed on the upper armored deck bringing its thickness to 4¾ inches. This, and other small additions, added over 1,000 tons of additional armor. A new 4¾-foot-deep antitorpedo blister was added over most of the ships' length and an extra torpedo bulkhead installed in the area of the boiler rooms. The overall depth of torpedo protection was now 19 feet.

Firepower augmentations included increasing the elevation of the 14-inch turrets to 30 degrees. Antiaircraft protection was greatly increased with eight 5-inch/25 dual-purpose guns and eight .50-inch machine guns. The torpedo tubes were removed, and two new catapults fitted, one on the quarterdeck and one on top of Turret 3.

This port-bow aerial view of *Arizona* was taken in 1931 just after completion of her modernization. The casemates on the main deck for the 5-inch/51 secondary battery are visible, as is the single 5-inch/51 mount and the four port-side 5-inch/25 antiaircraft guns on the deckhouse.



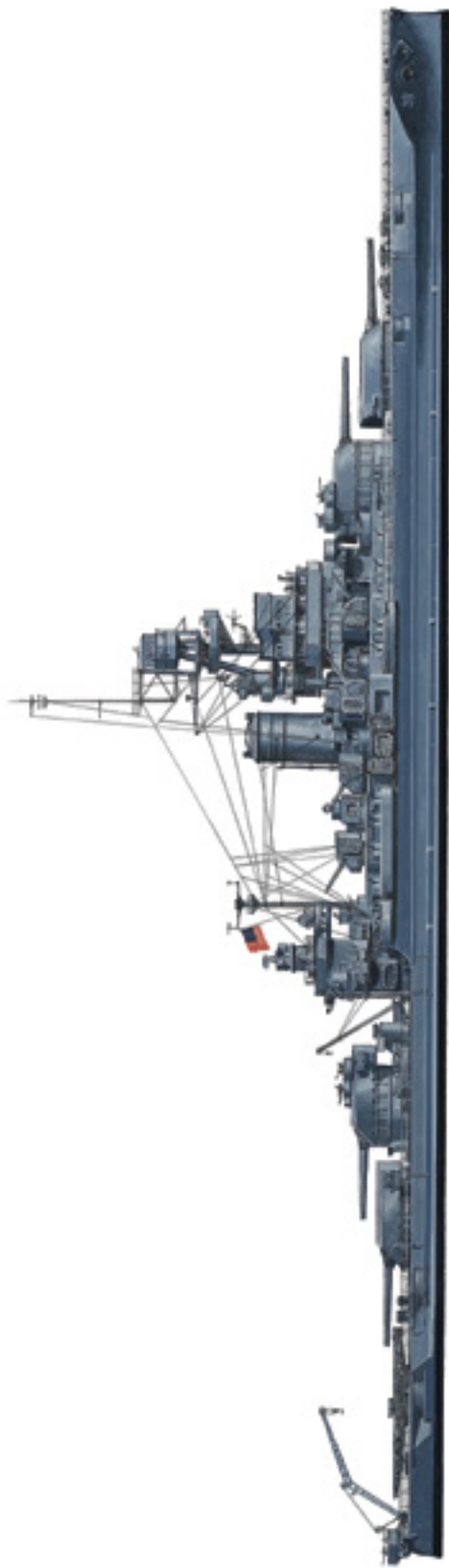
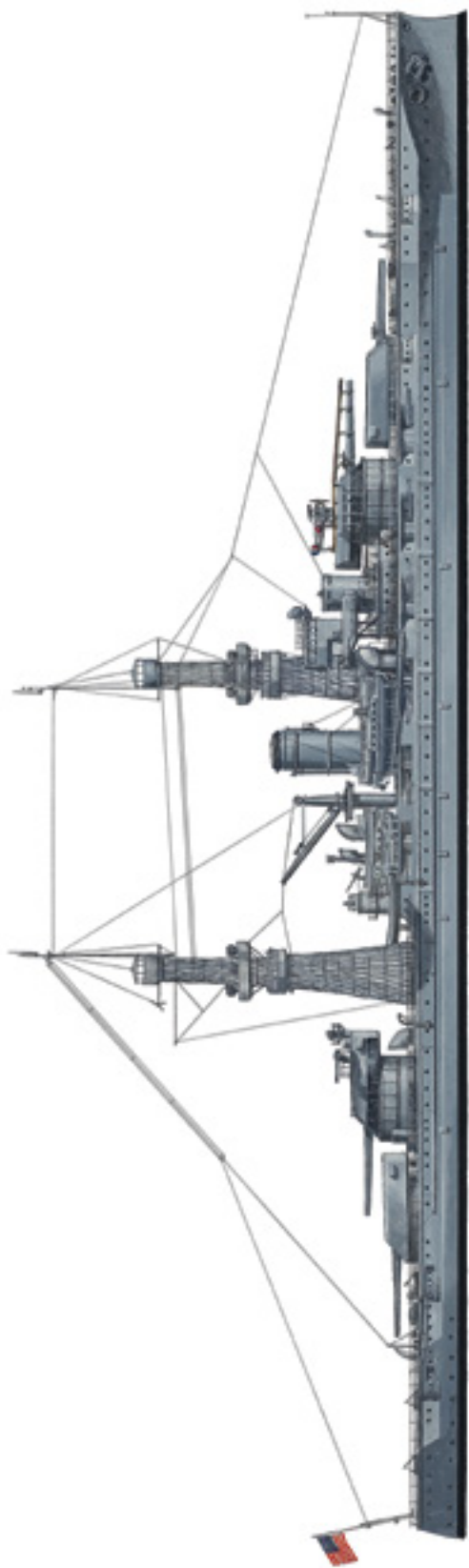
As war loomed, more efforts were made to increase antiaircraft protection. During *Arizona*'s June 1941 refit, eight .50-calibre machine guns were added (four on the mainmast, two on the foremast and two on the stack). Positions for the 1.1-quad guns were provided, but none were fitted because of shortages. Splinter shields for all 5-inch/25 guns were provided. *Pennsylvania* received similar modifications before the war. After the Pearl Harbor raid, *Pennsylvania* was fitted with four 1.1-inch quad mounts and 16 20mm single guns in early 1942.

From October 1942 to February 1943, *Pennsylvania* underwent refitting and major

C

THE PENNSYLVANIA CLASS

The top profile shows *Arizona* (side view) in 1921. Note the austere bridge structure and the two cagemasts. Casemates on the hull contain most of the secondary armament, which made its use problematic in any kind of sea. The bottom view is *Pennsylvania* on October 1944 in her late-war configuration during the battle of Leyte Gulf. The ship is in the Measure 21 (Navy Blue scheme). The aft control top has been replaced by a polemast, while the forward control top is retained. All the 5-inch/51 secondary guns have been removed and replaced with a dual-purpose battery of twin 5-inch/38 mounts.



Wartime Modifications to Pennsylvania-Class Battleships						
	5-inch/51	5-inch/25	5-inch/38	40mm	1.1-inch/3-inch	20mm
<i>Pennsylvania</i> and <i>Arizona</i> (12/41)	10	8	0	0	0	0
<i>Pennsylvania</i> (2/43)	0	0	16	40	0	51
<i>Pennsylvania</i> (8/45)	0	0	16	42	0	71

modification. The armored conning tower was removed to save top weight, and similarly the mainmast was removed and replaced by a small superstructure upon which the after main battery director rested. The foremast was retained and the bridgework on the forward superstructure simplified. A new deckhouse was built to take the new dual-purpose battery of eight 5-inch/38 mounts. These were controlled by two Mark 37 directors. The catapult on top of Turret 3 was removed, as were the prominent boat cranes. All the 5-inch/51 guns were removed. The new antiaircraft suite included ten 40mm quad and 51 20mm single mounts, and the eight prewar machine guns were retained.

A March–July 1945 refit added the Mark 34 main battery director on the aft superstructure, which was equipped with the modern Mark 8 fire-control radar. The antiaircraft suite was further augmented in the face of the kamikaze threat (see table).

A twin 40mm mount was added atop Turret 2, and 22 twin 20mm mounts were added.

Pennsylvania pictured after the Pearl Harbor raid in Drydock No 1. Because she was in dry dock, *Pennsylvania* was the least damaged of the eight battleships present during the attack. The two destroyers ahead of the battleship are *Cassin* and *Downes*, which were destroyed.



Wartime Service

Pennsylvania joined the Atlantic Fleet upon completion and assumed duties as fleet flagship. In 1922, she was sent to the Pacific where she remained until 1929, when she was placed back into the yards for modernization. The work took from June until May 1931. *Pennsylvania* was at Pearl Harbor on December 7, but since she was in dry dock, she was immune from torpedo attack. The only damage during the attack was from a dive-bomber of the second wave. A 550lb bomb hit the boat deck and exploded in a 5-inch gun casemate. Damage was light, but 16 men were killed and 30 wounded. The ship was repaired by March 1942. In October that year, the potential Japanese threat to the US west coast had receded and *Pennsylvania* was taken out of service for her first wartime refit, which lasted until February 1943.

On May 11–12, 1943, *Pennsylvania* began active operations by bombarding Japanese positions on Attu Island in the



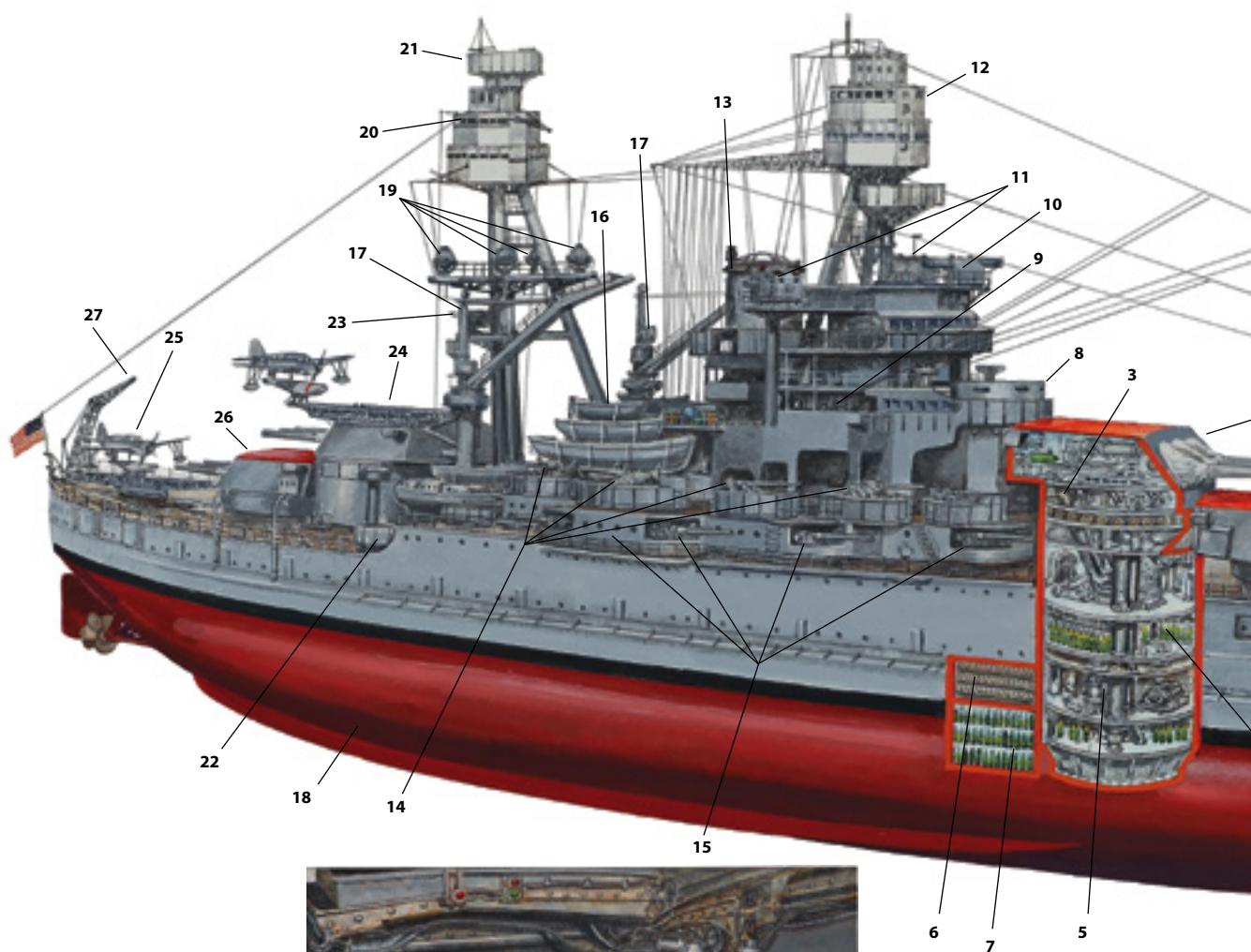
Pennsylvania met an ignominious end as part of the target fleet for Operation *Crossroads*, the atomic bomb tests at Bikini Atoll. She was anchored at the fringe of the test area and survived the tests on July 1 and 25, 1946. Following the tests, she was towed to Kwajalein lagoon and was decommissioned on August 29. She was used for radiological studies until 1948. Since she was still too contaminated to board, she was towed into deep water and scuttled on February 10, 1948.

Aleutians. This was repeated against Kiska Island in July and August. *Pennsylvania* was the flagship of the invasion force that landed on the Gilberts in November 1943 and Kwajalein and Eniwetok in the Marshall Islands during January–February 1944. The next major operation was the attack on the Marianas, and *Pennsylvania* was again present engaging targets on Saipan, Tinian and then Guam from June 14 through August 3. To give an example of the extent to which the older battleships were active in the gunfire support role, between July 12 and 14 *Pennsylvania* pounded Guam with 1,797 14-inch and 9,543 5-inch shells. Next she supported the invasion of the Palau Islands in September 1944. The following month, *Pennsylvania* bombarded Japanese positions on Leyte in the Philippines. The American invasion prompted a major response from the IJN, and on the night of October 25, 1944, *Pennsylvania* and five other USN battleships were positioned in Surigao Strait to block the entry into Leyte Gulf of a Japanese force that included two battleships. Of the six American battleships present, *Pennsylvania* had the least modern fire-control equipment, and she was unable to find a target during the night engagement, so did not open fire. She supported the invasion of Luzon in January 1945, and then returned to the USA for a refit. After returning to service in July, she was anchored off Okinawa on August 12 when she was hit by a single aircraft-launched torpedo. The torpedo hit aft, damaging three of the four shafts, and caused severe flooding. Twenty crewmen were killed and ten wounded. The ship was saved, but crawled back to the USA on a single shaft. With the end of the war, *Pennsylvania* was clearly excess to requirements and she was allocated to the July 1946 atomic tests off Kwajalein. The old battleship survived the tests on July 1 and 25, but was decommissioned and then scuttled off Kwajalein on February 10, 1948.

The fate of *Arizona* is well known. After commissioning, she saw service briefly in the Atlantic Fleet before being transferred to the Pacific in 1921. Her major modernization took place from July 1929 to March 1931, after which she returned to the Pacific. At the beginning of war she was the flagship

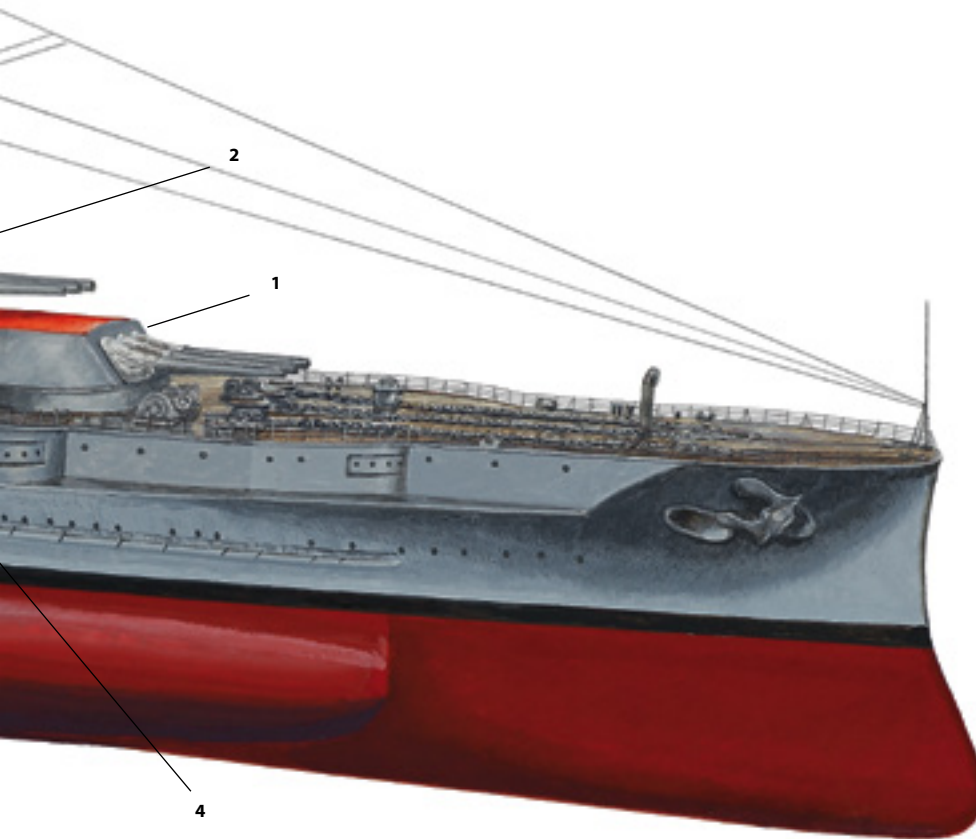
Arizona as she appeared in December 1941 at the time of her destruction at Pearl Harbor. This tragic event made her arguably the most famous of the older American battleships. The plate

shows the ship in her early-war configuration and paint scheme. The ship is in the prewar Measure 1 scheme.



KEY

1. No.1 14-inch/45 gun turret
2. No.2 14-inch/45 gun turret
3. Shell hoist
4. Shell handling room
5. Powder handling room
6. Powder magazine
7. Shell magazine
8. Conning tower
9. Navigation bridge
10. 20-foot rangefinder for main battery
11. Mark 19 director (2) for 5-inch antiaircraft guns
12. Foremast with forward fighting top
13. Stack
14. Starboard side 5-inch/25 dual purpose guns (4)
15. Starboard side 5-inch/51 guns (5; 4 are shown)
16. Ship's boats
17. Boat and aircraft cranes (2)
18. Starboard side torpedo blister
19. 36-inch searchlights (4)
20. Mainmast with aft fighting top
21. "Birdbath" with four Browning .50-caliber machine guns
22. Vacant position for 1.1-inch quad machine cannon
23. 12-foot rangefinder for main battery
24. No.3 14-inch/45 gun turret with catapult
25. OS2U-3 Kingfisher observation aircraft (2)
26. No.4 14-inch/45 gun turret
27. Aft aircraft crane



The bridge and foremast of *Arizona* after it had stopped burning following the December 7 attack. The force of the forward magazine explosion shattered the forward part of the ship, eliminating any possibility of salvage. Almost nobody survived from the forward part of the ship, including her captain and an embarked admiral. In total, 1,177 officers and men were killed, almost half of the 2,335 military dead suffered during the attack.



Idaho in New York still fitting out before her launch in March 1919. The armored conning tower can be readily seen right behind Turret 2. The need for a larger navigation bridge was soon identified, and this was added after completion. The hull positions for the forward 5-inch/51 secondary guns have been plated over.



for Battleship Division 1 and was in Pearl Harbor on December 7, 1941. She was moored next to repair ship *Vestal*, which meant she was largely protected from torpedo attack. To deal with the ships protected against torpedoes, the Japanese brought 49 level bombers into play, each with a specially modified armor-piercing 1,760lb bomb. Of the 49 bombs dropped, ten scored hits, but only four produced a full-order detonation. Two of these hit *Arizona*. The first hit the roof of Turret 4 and ricocheted toward the stern, where it pierced the deck, entered a compartment, and caused a fire but no major damage. The second hit was fatal. It occurred at 0806 hours while the Japanese torpedo aircraft attack was still unfolding. One of ten level-bombers from the carrier *Hiryu* hit *Arizona* on the starboard side at a point between turrets 1 and 2. The armor-piercing bomb lived up to its name, penetrating three decks including the main armored deck that had almost five inches of armor.

It then exploded in one of three starboard-side propellant-charge magazines, creating a fire. This quickly set off the two adjacent propellant-charge magazines, and within seconds, the hot gases ignited the port-side propellant-charge magazines, which led to a cataclysmic explosion of the forward magazine with its 582 tons of 14-inch shells. The explosion utterly destroyed the forward part of the ship, which made her salvage impossible. *Arizona* remains on the floor of Pearl Harbor where she was sunk. In 1962, a memorial was erected across her shattered hull.

New Mexico Class

Design and construction

Following the completion of design work on the Pennsylvania class, the General Board (responsible for formulating and approving ship design) saw a need for an entirely new battleship design to keep pace with European and Japanese ships. This new design was to be over 35,000 tons, possess better protection, and would be fitted with the more powerful 16-inch gun. This was an expensive proposition, and the Secretary of the Navy did not approve it, so the 1914 battleship-building program was essentially a repeat of the Pennsylvania class with minor improvements. Two ships were proposed, *New Mexico* (BB40) and *Mississippi* (BB41), but the sale of pre-dreadnoughts *Idaho* and *Mississippi* to Greece in 1914 brought enough funds for a third ship, which became *Idaho* (BB42).

New Mexico-Class Construction				
Ship	Built at	Laid down	Launched	Commissioned
<i>New Mexico</i>	NY Shipbuilding	Oct 14, 1915	Apr 23, 1917	May 20, 1918
<i>Mississippi</i>	Newport News	Apr 5, 1915	Jan 25, 1917	Dec 18, 1917
<i>Idaho</i>	NY Shipbuilding	Jan 20, 1915	Jun 30, 1917	Mar 24, 1919

Despite only incremental improvements to the New Mexico class, there were important visual differences to the new design. This was primarily due to the decision to use a clipper bow to address the wetness problem in place of the ram bow on previous USN dreadnoughts. Displacement was marginally larger and the hull was some 16 feet longer.

Protection

The only difference between the protection scheme of the New Mexico class and the preceding Pennsylvania class was the upper armored deck, which was thickened to 3½ inches.

Propulsion

The machinery was similar to that on the Pennsylvania class, with nine boilers driving four direct-drive turbine shafts. Output was 32,000shp, which was adequate for 21 knots. One of the three units, *New Mexico*, was fitted with a turboelectric power plant to test the suitability of the system on battleships. The promise of turboelectric drive was greater efficiency, which translated into a greater radius and the ability to provide much greater



New Mexico in 1918 just after completion. She has been fitted with a clipper bow, which gives her a distinctly more modern appearance than earlier USN dreadnoughts.

Mississippi on October 2, 1917, while the ship is still fitting out. She lacks key equipment like rangefinders and searchlights. As can be seen in this view, the ship was completed with hull casemates for a 5-inch/51 secondary battery (two are evident under the forward 14-inch gun turrets). These were soon removed, and the next two ships of the class had these casemates plated over prior to completion.



internal subdivision in the machinery spaces. The ship had two electric generators that produced power for four electric motors. These were coupled to the four shafts. This arrangement produced 27,000shp, which was adequate for 21 knots. The system proved successful and was adopted for use on subsequent battleship classes.

New Mexico-Class Specifications (as built)				
Displacement	Dimensions	Speed	Range	Crew
32,000 tons standard; 33,000 tons full load	Length 624ft overall; Beam 97½ft; Draft 30ft	21kt	8,000 miles at 10kt	1,084

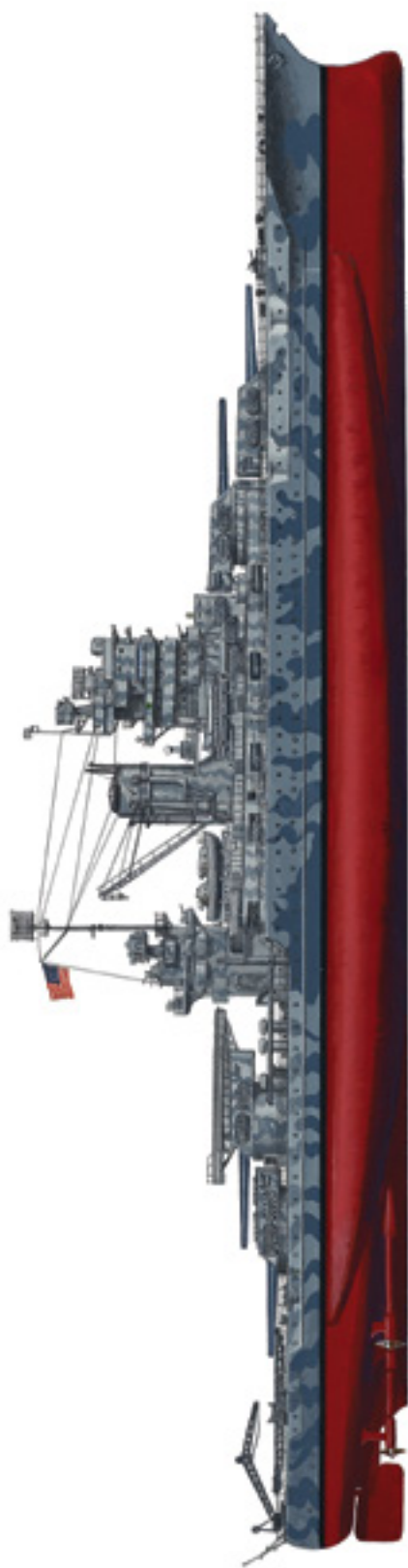
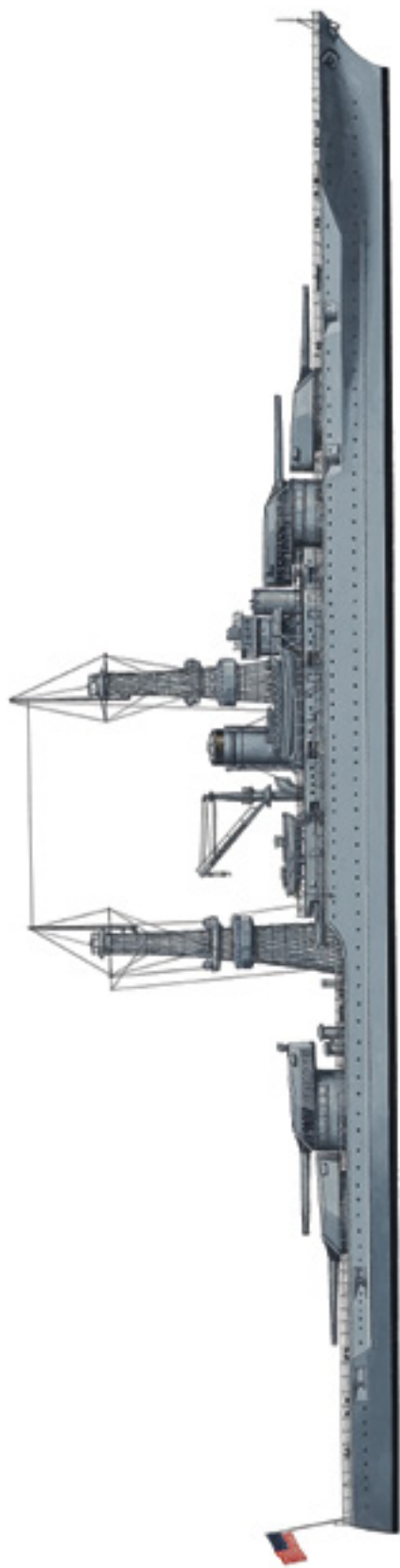
Armament

The main battery was kept at 12 guns, but these were the new 14-inch/50 guns, which were placed in redesigned turrets that allowed each gun to elevate independently. As completed, the guns could be elevated to 30 degrees, resulting in a big improvement in range. The secondary battery was also improved, at least in regards to its placement in the ship. It was reduced to 14 5-inch/51 guns, but these were placed in the deckhouse, which permitted them to be worked in all types of seas. The first ship of the class to be completed, *Mississippi*, was actually fitted with the originally planned 22 5-inch/51 guns, but eight of these in the casemates were immediately removed. Four 3-inch guns were provided for antiaircraft protection and the two useless submerged 21-inch torpedo tubes were retained.

E

THE NEW MEXICO CLASS

The first profile is *Mississippi* in 1917 as she appeared when she was commissioned. The ship looks much like the two preceding classes of superdreadnoughts, with the most notable exception of the clipper bow. More subtle differences include the placement of the secondary battery and the new type of 14-inch gun turret. The bottom profile is *New Mexico* as she appeared in January 1942 before being deployed to the Pacific. The camouflage scheme is the Measure 12 (modified), which was applied in December 1941 and worn only briefly. The appearance of the New Mexico class was marked by its large bridge structure and lack of large control tops or tripod masts.





New Mexico fitting out at the New York Navy Yard on April 3, 1918. The ship has yet to be painted, so the outline of the armor belt can easily be discerned. The belt did not cover the entire side of the hull, but was positioned low on the ship to protect vital areas.

Service Modifications

In 1919, aircraft platforms were added on top of the two superfiring turrets, but were removed shortly thereafter. The antiaircraft battery was increased to eight 3-inch guns in 1921. Some of the first USN catapults were fitted in 1923, one on the quarterdeck and one on Turret 3.

Between 1931 and 1934, these ships received the most extensive modernization of any USN dreadnought. This meant that at the start of the Pacific War, the *New Mexico* class was the most modern in the fleet, aside from the newly completed *North Carolina* class. Horizontal protection was

increased from 3½ to 5½ inches on the upper armored deck. The splinter deck over the machinery spaces was increased to 2¾ inches. To increase torpedo protection, a blister was fitted and an additional bulkhead fitted outside the existing one; this increased the beam by 9 feet.

Propulsion was also upgraded, with the original nine large-tube boilers being replaced. All three ships were fitted with turboelectric drive, and even the *New Mexico*, which already had electric drive, had hers replaced to standardize with the rest of the class. Speed remained just over 21 knots, but the increased power (40,000shp) made up for the blisters and the increased displacement.

The ships' appearance was altered, with a new tower designed to reduce the effect of shells and blast. The new superstructure moved the fire-control equipment to a position lower than on the modernized *Nevada*- and *Pennsylvania*-class units (thus reducing their range), but this disadvantage was accepted. *Idaho* was fitted as a flagship and therefore had a flag bridge below her navigation bridge. The ships' searchlights were moved to a position on the single stack. The height of the stack was increased and the cagemasts were replaced by polemasts.



Idaho in June 1927 before she was taken out of service for her reconstruction. This view shows the battleship still with cagemasts and a small bridge structure.

The alteration to the armament was not as dramatic. The 3-inch guns were replaced by 5-inch/25s, and eight .50-inch machine guns were added. The submerged torpedo tubes were removed.

In 1941, the entire class was supposed to receive 1.1-inch quad mounts, but these were unavailable, so four 3-inch guns were added. The two 5-inch/51 guns in open mounts on the forward deckhouse were removed. Before dispatch into the Pacific after Pearl Harbor, the ships were given radar, 1.1-inch quad mounts, and 14 20mm single guns.

Wartime Modifications to New Mexico-Class Battleships						
	5-inch/51	5-inch/25	5-inch/38	40mm	1.1-inch/3-inch	20mm
<i>New Mexico</i> (12/41)	10	8	0	0	4	0
<i>New Mexico</i> (12/42)	6	8	0	8	4	14
<i>New Mexico</i> (10/43)	6	8	0	28	0	24
<i>New Mexico</i> (12/44)	6	8	0	40	0	46
<i>Mississippi</i> (10/43)	6	8	0	28	0	29
<i>Mississippi</i> (12/44)	6	8	0	40	0	40
<i>Mississippi</i> (4/45)	0	16	0	48	0	40
<i>Idaho</i> (2/43)	0	8	0	40	0	43
<i>Idaho</i> (1/45)	0	0	10	40	0	43

The ships were needed in service, so there was little chance for major reconstruction during the war. The accompanying table gives the fit for the class at various points during the conflict. The desired fit for November 1942 called for the removal of the 5-inch/51 guns, the retention of the eight existing 5-inch/25 mounts, and the addition of ten 40mm quadruple mounts and 40–45 20mm single mounts. Eventually all three ships approached this arrangement, and some were given additional anti-aircraft capability late in the war in the face of the kamikaze threat.



New Mexico in January 1938, showing her post-modernization configuration. She is identifiable by the Mark 28 directors atop the bridge, which was added in 1936. Note the catapults on Turret 3 and on the quarterdeck.

Idaho reached the desired fit during her refit of October 14 to December 28, 1942, and had four 5-inch/51 guns removed and the number of searchlights reduced to two. By 1944, the other two ships reached this condition. Adding a battery of 5-inch/38 guns in place of the 5-inch/25s was considered, but because of top weight and time issues, this was never accomplished.

Idaho had another extensive late-war refit, which the other ships did not. Between October 1944 and January 1945, ten single 5-inch/38 guns in enclosed gun mounts replaced the open 5-inch/25 mounts.

Following kamikaze damage, in March–April 1945 *Mississippi* had her 5-inch/51 guns removed and eight 5-inch/25 guns were added (doubling the existing battery), along with 12 40mm (a 13th mount was added later) and 40 20mm mounts. Mark 51 directors were installed to control them. To compensate for the extra weight, the conning tower was removed.

Wartime Service

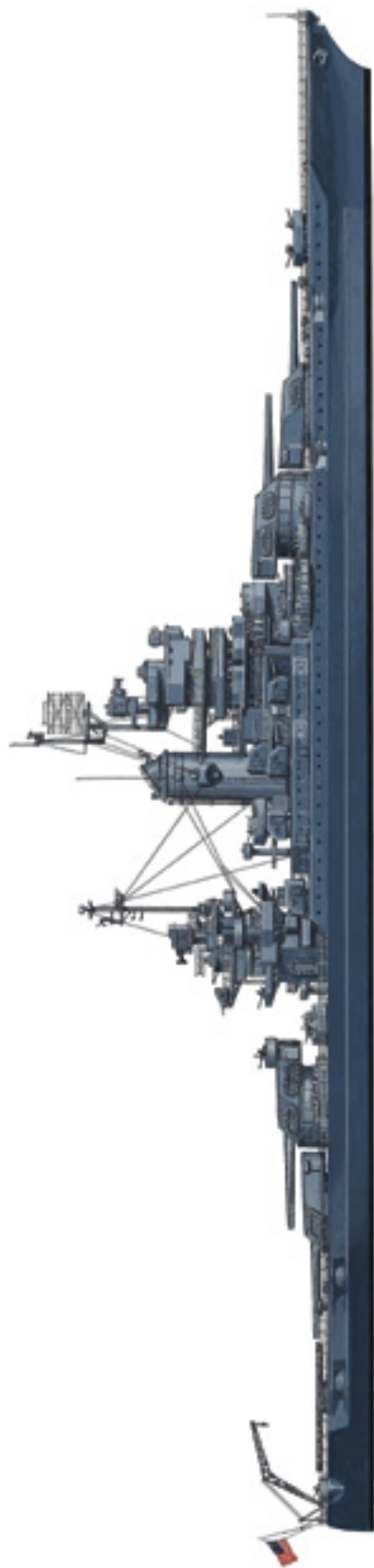
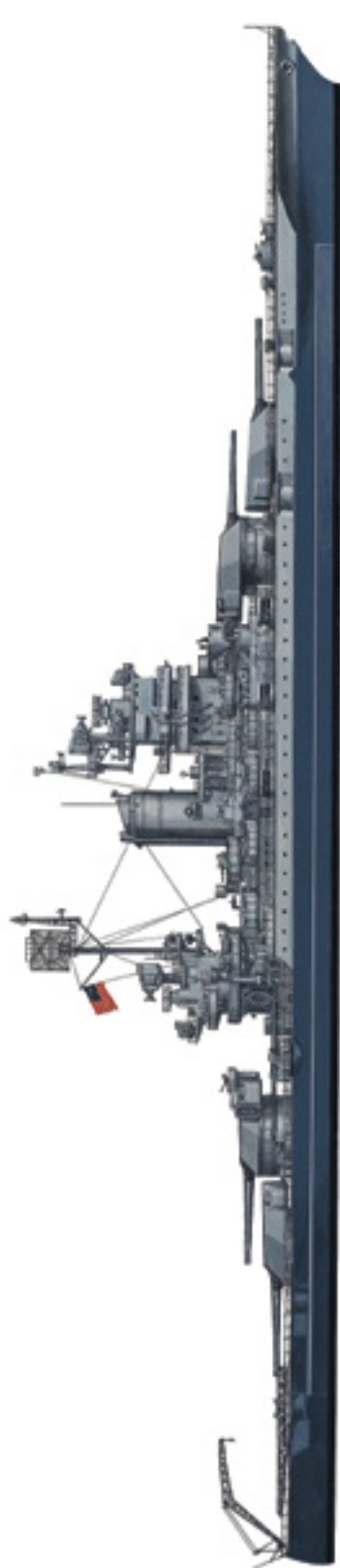
New Mexico spent most of her early career in the Pacific Fleet before commencing her extensive modernization between March 1931 and January 1933. Following reconstruction, she returned to the Pacific until being moved into the Atlantic in June 1941 for duties in the so-called Neutrality Patrol. These were conducted under virtual wartime conditions, and included patrols in the Denmark Strait looking for German surface raiders. After the Pearl Harbor attack, she was quickly recalled to the Pacific to reconstitute the USN's depleted battle line. After duties off the US west coast and into the southeast Pacific, she assumed the gunfire support role for a series of amphibious operations. These included the Aleutians in May and July 1943, and then the Gilberts in November. In January 1944, she took part in the attack on Kwajalein, and then bombarded Japanese-held Wotje Island in February and Kavieng on New Ireland Island in March. *New Mexico* was present throughout the Marianas campaign, supporting the invasions of Saipan, Tinian, and Guam in June and July 1944.

After a refit from August to October, she returned to service in November, supporting the ongoing invasion of Leyte. In December, she supported the invasion of Mindoro in the Philippines, and then took part in the major operation to land troops on Luzon in January 1945. While entering Lingayen Gulf on January 6, she was hit by a single kamikaze on her bridge. This did not cause major damage, but did kill 30 (including her captain) and wounded 87. Following repairs at Pearl Harbor, she participated in the preliminary bombardment of Okinawa in March. Later, off Okinawa, she was struck again by another kamikaze attack and a bomb from a second on May 12. This time, the aircraft struck the starboard side, causing fires and heavy casualties (57 dead and 119 wounded). By the time repairs were completed,

F

NEW MEXICO CLASS, LATE WAR

The top profile is *Mississippi* in 1943 as her appearance begins to change with new antiaircraft guns and radar. The ship is in the Measure 22 scheme. The electronics upgrade is evident, with the SK air search on the mainmast and the SG surface search radar on the foremast. All the fire-control directors for the main and secondary batteries are radar-equipped. All but six of the 5-inch/51 guns have been removed, and ten 40mm quad mounts are visible along with a large number of single 20mm mounts. *Idaho*, below, was the most heavily modified New Mexico-class ship. All 5-inch/51 casemate guns and the 5-inch/25 guns have been deleted and replaced by ten single 5-inch/38 mounts. The number of 40mm quad mounts has now reached 12.



An aerial port-quarter view of *Mississippi* under way on July 1945. The ship is bristling with a heavy antiaircraft battery, including 16 5-inch/25 single guns and 12 40mm quad mounts, the most of any ship in her class. A single catapult remains on the quarterdeck, and an SK radar is on the mainmast.



the war had ended. Excess to requirements, she was decommissioned in 1947 and sold for scrap later the same year.

Mississippi was the first ship in the class to be commissioned in 1917. In 1919, she moved to the Pacific Fleet, where in 1924 she suffered an accident in one of her 14-inch gun turrets, which killed 48 crewmen. From March 1931 until August 1933, she underwent extensive modernization before returning to the Pacific Fleet. In June 1941, she also was assigned to the Neutrality Patrol in the Atlantic, which included two months off Iceland patrolling for German raiders.

After Pearl Harbor, she immediately returned to the Pacific where she joined *New Mexico* in a series of operations off the US west coast while making no contact with the Japanese. In July, she was active in the Aleutians. *Mississippi* joined the Gilberts operation, but while conducting a bombardment of Makin Island suffered another 14-inch turret explosion, this time losing 40 men. Repairs were completed in time for the invasion of the Marshalls in January 1944. A refit caused her to miss the invasion of the Marianas in June, but she returned for the September invasion of the Palau Islands and the invasion of Leyte in October. *Mississippi* was also present at the last-ever clash of battleships at Surigao Strait on October 25, but like

New Mexico firing her 14-inch guns in support of the landing of US troops on Okinawa on April 1, 1945. *New Mexico* was active off Okinawa from March 26 until struck by a kamikaze on May 12. From April 5, she was also the flagship of the Fifth Fleet.





New Mexico sustained her first damage of the war when she was successfully attacked by two kamikazes on May 12, 1945. Intense fires were started that caused heavy personnel casualties, but were extinguished in 21 minutes. The crash caused a large hole in the hull and other damage, which required her to leave the battle zone.

Pennsylvania her dated fire-control system kept her out of the action. She managed to fire only a single 14-inch salvo at the end of the engagement. On January 9, 1945, *Mississippi* was hit by a single kamikaze that crashed on the upper deck. Damage was slight, and the ship remained on station until February 10. Following repairs at Pearl Harbor, she participated in the Okinawa campaign beginning on May 6. On June 5, she was again struck by a kamikaze, which hit the hull on the starboard side causing little damage.

After the war, *Mississippi* went on to have a second life as a combination training and experimental ship. Work began in late 1945 to convert her to this new role. Only Turret 4 remained from her main battery, and in the place of the other 14-inch gun turrets a new 6-inch/47 dual-purpose turret and the experimental 5-inch/54 gun were fitted. Some standard 40mm and 5-inch/38 weapons were retained for training. *Mississippi* was reclassified as EAG-128 (experimental auxiliary) and re-entered service in 1948. Later, she was fitted aft with two Mark 1 launchers for the Terrier anti-aircraft missile system. This



Another starboard-beam view of *Mississippi* dating from 1934. This shows the battleship's post-modernization configuration, which was dominated by the large bridge structure. Unlike previous USN dreadnoughts after modernization, the ship carries no large tripod masts. Three aircraft can be seen on the catapults. These were used for spotting of gunfire and were thus an important part of the ship's fire-control system.



LEFT

Idaho in Hvalfjord, Iceland in October 1941. When President Roosevelt began the so-called Neutrality Patrol to keep German forces out of the western Atlantic in 1941, the only USN battleships in the Atlantic were the three oldest units in the fleet. To deal with the possible breakout of German surface raiders, the three ships of the New Mexico class were deployed into the Atlantic in June. These ships spent much of the brief period in the Atlantic deployed to Icelandic waters to counter such a breakout.

RIGHT

Idaho pictured on February 16, 1945, during the invasion of Iwo Jima. She was the only New Mexico-class ship not to be damaged during the war.



was the first system of its kind to enter USN service, and the first firings occurred on *Mississippi* in 1953. The old battleship was finally decommissioned in September 1956 and sold for scrap that December.

Upon commissioning in 1919, *Idaho* was assigned to the Pacific Fleet. From late 1931 until October 1934, she underwent her modernization and then returned to service in the Pacific Fleet. With the other ships in her class, she was moved into the Atlantic in June 1941 for Neutrality Patrol duties. When war came in December 1941, she was in an Icelandic port, but quickly departed to return to the Pacific. Like her sister ships, she conducted patrols through 1942, primarily out of bases in California, but saw no action. In October 1942, she was taken out of service for a major refit. Finally, in May 1943, *Idaho* saw combat with a bombardment of Attu. Following her combat debut, she participated in series of invasion operations: Kiska in August; Makin Island in November; the Marshall Islands in January 1944, where she shelled Kwajalein on January 31; a bombardment of Kavieng on April 20, 1944; Saipan in June; Guam in July; and Peleliu Island in the Palaus from September 12 to 24. A last refit from late October to January 1945 forced her to miss the Leyte operation and invasion of Luzon.

Idaho returned in time for the invasion of Iwo Jima in February 1945. From March 26 until April 20, she supported the landings on Okinawa. As the campaign dragged on, she returned to Okinawa for a second tour of duty on May 22 and remained off the island until June 20. Following the end of the war, she was decommissioned in July 1946 and sold for scrap the following year.

G

USS NEW MEXICO

On January 6, 1945, *New Mexico* was one of six battleships operating as part of TG 77.2 providing support to the invasion of Luzon Island in the Philippines. The entry of the American invasion force into Lingayen Gulf prompted the Japanese to make a maximum effort to disrupt the invasion. Two battleships were hit by kamikazes. The single kamikaze to hit *New Mexico* struck the navigation bridge. Though it killed 30 crewmen, including the ship's captain and an embarked US Army lieutenant general, damage overall was minimal and the ship was able to continue its mission. *New Mexico* is in the Measure 32/6D scheme. The intense antiaircraft barrage put up by the battleship and her escorts was not able to protect the ship from a kamikaze attack this time. In three more days, *Mississippi* would suffer a similar fate, but again damage was light.



ANALYSIS AND CONCLUSION

As designed and modernized, the Nevada, Pennsylvania and New Mexico classes were superior to their British and Japanese contemporaries in overall protection, particularly horizontal protection. Like almost all battleships of the day, the Achilles' heel of USN prewar battleships was a lack of adequate underwater protection. In the area of speed, the older USN battleships were inferior to British and Japanese ships, which could have been an important tactical consideration had the decisive battle fleet engagement envisioned by both the USN and IJN ever occurred. Overall, though, the American emphasis of superior sustainability in the form of greater protection was probably a better choice than higher speed, for which the IJN seemed to have an enduring fascination. In terms of hitting power, USN ships compared favorably to their IJN counterparts. Eight of ten prewar IJN battleships carried 14-inch guns. Of these eight, half carried only eight guns and the other half carried 12, so the standard USN prewar battleship with its 10–12 14-inch guns possessed a slight potential advantage. In terms of fire control, USN battleships started out being inferior to their RN contemporaries in World War I, but in the interwar period they could be considered equal to RN and IJN battleships since all were using the same basic technology. However, with the advent of radar, the USN applied it more quickly and effectively to achieving fire-control solutions for long-range gunnery.

Major Wartime Damage to Nevada, Pennsylvania and New Mexico Classes			
Ship	Agent of Damage	Date	Fate
<i>Nevada</i>	1 torpedo, 5 550lb bombs	Dec 7, 1941	Beached, later salvaged
<i>Oklahoma</i>	5 torpedoes	Dec 7, 1941	Capsized, not salvaged
<i>Pennsylvania</i>	1 550lb bomb	Dec 7, 1941	Minor damage
<i>Arizona</i>	2 800kg bombs	Dec 7, 1941	Destroyed by magazine explosion
<i>New Mexico</i>	Kamikaze	Jan 6, 1945	Minor damage
<i>Mississippi</i>	Kamikaze	Jan 9, 1945	Minor damage
<i>Nevada</i>	Kamikaze	Mar 27, 1945	Minor damage
<i>Nevada</i>	5 medium-caliber shells	Apr 5, 1945	Minor damage
<i>New Mexico</i>	Kamikaze	May 12, 1945	Moderate damage
<i>Mississippi</i>	Kamikaze	Jun 5, 1945	Minor damage
<i>Pennsylvania</i>	1 torpedo	Aug 12, 1945	Almost sunk

There is a limited basis for directly comparing USN prewar battleships with their Japanese peers. The only occasion when any of these USN battleships took part in a surface engagement against Japanese battleships was in October 1944 at the battle of Surigao Strait. This was not a true test, however, since it featured an overwhelming USN force of six battleships and eight cruisers against a Japanese force that had been whittled down to a single battleship, already damaged by USN destroyer torpedoes, and an accompanying heavy cruiser by the time the gunnery phase of the engagement took place. The outcome in this case was not in doubt, but it is still noteworthy that no major USN ship was even damaged in the engagement. However, had USN prewar battleships had the opportunity to

engage in a major fleet action against the IJN, they could have been expected to perform well against Japanese battleships with the exception of the two superbattleships of the Yamato class with their 18.1-inch guns. USN battleships were better protected than their IJN dreadnought contemporaries, and possessed superior fire-control systems for their main batteries. The only wild card in such an engagement was whether the USN battleships would be exposed to an intense IJN torpedo threat. Even after their prewar modernization, the record of older USN battleships against Japanese torpedoes was not good. The case of *Oklahoma* was exceptional, since any battleship of her era would have been overwhelmed by five torpedo hits, but the cases of *Nevada* and *Pennsylvania* being severely damaged by a single torpedo at different points in the war demonstrated that underwater protection was still a weakness. This was against the IJN's Type 91 air-launched torpedo with a 529-pound warhead; the Type 93 torpedo carried by IJN cruisers and destroyers had a much larger 1,080-pound warhead. Two of these were sufficient to sink a USN prewar heavy cruiser, and a similar number would have likely crippled any USN prewar battleship.

USN prewar battleships were largely untested after Pearl Harbor against conventional air attack. The scale of anti-aircraft weaponry fitted to older USN battleships and the high quality of these weapons was sufficient to deal with the limited scale of conventional IJN air attack encountered later in the war. Even battleships, however, were not immune to the effects of kamikazes, but at least when they were hit the ships' heavy armor limited damage. Kamikazes could inflict topside damage and inflict personnel casualties, but they could not penetrate to vital areas. It is important to note that only a single ship of the three classes examined in this book was damaged by conventional air attack after Pearl Harbor.



Battleship Row during the first few minutes of the Japanese attack on Pearl Harbor. From left to right are *Nevada*, *Arizona* (with repair ship *Vestal* alongside), *Tennessee* (inboard), *West Virginia*, *Oklahoma*, *Maryland* (inboard), oiler *Neosho* and *California*. It can easily be seen why *West Virginia* and *Oklahoma* were most vulnerable to torpedo attack. Both have already been hit by torpedoes and *West Virginia* is starting to list.

Battleship Row after the raid. *Nevada* is no longer present, since she got under way during the attack. The ship in the lower left is the shattered *Arizona*. Ahead of her are *Tennessee* (inboard) and *West Virginia*, which has settled on an even keel. The next pair is *Maryland* and the capsized *Oklahoma*. *California* is at the upper right; she has also taken a torpedo hit and settled on the mud of the harbor. The attack on Pearl Harbor demonstrated the vulnerability of older USN battleships to torpedo damage.

It is generally thought that the older USN battleships played little part in the war. This is probably for two reasons. These ships lacked the speed to escort the fast carriers, leaving this duty to the much more glamorous and better-known fast battleships of the North Carolina, South Dakota and Iowa classes. Perhaps, more importantly, the attack on Pearl Harbor gave the mistaken impression that the Pacific Fleet's battle line had been wiped out, a perception reinforced by the fact that the older battleships were not employed in the forward areas through 1942. The lightly damaged survivors of Pearl Harbor, *Pennsylvania*, *Tennessee*, and *Maryland*, were joined by the undamaged *Colorado* and the three ships of the New Mexico class to form a powerful battle line in early 1942. This force, known as Task Force 1, was not employed in the forward areas despite the constant prodding by Admiral King of Pacific Fleet Commander Admiral Chester Nimitz to find active employment for them. Exactly why Nimitz did not use them in the forward area remains unclear. He protested to King that it was for logistical concerns, but the real reason was probably more to do with his assessment of the ability of the ships to withstand the Japanese torpedo threat. In any event, this speaks volumes of how the older battleships were viewed by the USN. Not fast enough to escort carriers, and not capable enough to operate as front-line units in the face of a major IJN threat, they were judged to be suitable only for support to amphibious forces and for dealing with the odd Japanese unit that might penetrate to the invasion area.



Nevertheless, as clearly shown in the accompanying table, the older battleships were busy from May 1943 until the end of the war. They were part of every major operation. The largest amphibious operation of the war, the invasion of Okinawa in April and June 1945, included ten older battleships. Beginning in May 1943, when the USN invaded Attu Island in the Aleutians, the older battleships found a role supporting amphibious invasions. In this role they proved very well suited. Their main battery was extremely powerful in a shore-bombardment role, and the ships could form a covering force able to take on any likely IJN attempt to intervene with the invasion force. While the IJN's older battleships sat in home waters with no role except to wait for the increasingly unlikely major fleet surface engagement, the older USN battleships were constantly busy providing antiair and surface screening to amphibious forces. Their most useful contribution was providing gunfire support to American ground troops as they attempted to expel well-dug-in Japanese defenders from a seemingly endless succession of Pacific islands. In this capacity, they excelled by all accounts. The old battleships were ideally suited for this role since they possessed a combination of endurance on station, great range and accuracy of fire, and immense destructive power. Though they never were the centerpiece of a decisive naval engagement against the IJN, they did make real contributions to the USN's victorious Pacific campaign.

USN Battleship Operations During World War II Involving Ships of the Nevada, Pennsylvania or New Mexico Classes		
Operation	Time Period	Ships Participating
Pearl Harbor	December 1941	<i>Nevada, Oklahoma, Pennsylvania, Arizona, Tennessee, California, Maryland, West Virginia</i>
Task Force 1 (eastern Pacific defense)	January–October 1942	<i>Pennsylvania, Maryland, Tennessee, Colorado, New Mexico, Mississippi, Idaho</i>
Aleutians Campaign	May–August 1943	<i>Nevada, Pennsylvania, Mississippi, Idaho, Tennessee</i>
Gilberts Invasion	November 1943	<i>Pennsylvania, New Mexico, Mississippi, Idaho, Tennessee, Colorado, Maryland</i>
Marshall Islands Invasion	January–February 1944	Same as for Gilberts
Bombardment of Kavieng	March 20, 1944	<i>New Mexico, Mississippi, Idaho, Tennessee</i>
Invasion of Northern France	June 1944	<i>Nevada, Arkansas, Texas</i>
Marianas Invasion	June 1944	<i>Pennsylvania, New Mexico, Idaho, California, Tennessee, Colorado, Maryland</i>
Invasion of Southern France	August 1944	Same as for Northern France
Palaus Invasion	September 1944	<i>Pennsylvania, Mississippi, Tennessee, Maryland, West Virginia</i>
Leyte Invasion	October–November 1944	<i>Pennsylvania, Mississippi, Tennessee, California, Maryland, West Virginia, New Mexico (November), Colorado (November)</i>
Luzon Invasion	January–February 1945	<i>Pennsylvania, New Mexico, Mississippi, California, West Virginia, Colorado</i>
Iwo Jima Invasion	February 1945	<i>Nevada, Idaho, Tennessee, Texas, New York</i>
Okinawa Invasion	April–June 1945	<i>Nevada, New Mexico, Mississippi, Idaho, Tennessee, Colorado, Maryland, West Virginia, Texas, New York</i>
East China Sea Sweep	July 1945	<i>Nevada, Pennsylvania, Tennessee, California, Arkansas, Texas</i>



One of the iconic images of the Pacific War shows *Pennsylvania* leading one other battleship and three cruisers in Lingayen Gulf in January 1945. This was part of the operation to invade the main Philippine island of Luzon and led to a strong response by Japanese suicide aircraft, which damaged battleships *Mississippi* and *New Mexico*.

BIBLIOGRAPHY

- Beigel, Harvey, *Parallel Fates*, Pictorial Histories Publishing Company (Missoula, Montana, 2004)
- Beigel, Harvey, *Two Ocean Battleships*, Pictorial Histories Publishing Company (Missoula, Montana, 2002)
- Campbell, John, *Naval Weapons of World War Two*, Naval Institute Press (Annapolis, Maryland, 2002)
- Doyle, David, *USS Arizona*, Squadron/Signal Publications (Carrollton, Texas [nd])
- Friedman, Norman, *Battleship Design and Development 1905–1945*, Mayflower Books (New York, 1978)
- Friedman, Norman, *U.S. Battleships*, Naval Institute Press (Annapolis, Maryland, 1985)



Friedman, Norman, Baker, Arthur, Lott, Arnold, and Sumrall, Robert, *USS Arizona (BB 39)*, Leeward Publications (Annapolis, Maryland, 1978)

Goralski, Waldemar, Wieliczko, Leszek, and Wisniewski, Piotr, *The Battleship USS Arizona*, Kagero Publishing (Lublin, Poland [nd])

Gregor, Rene, *Battleships of the World*, Naval Institute Press (Annapolis, Maryland, 1997)

Hodges, Peter, *The Big Gun*, Naval Institute Press (Annapolis, Maryland, 1981)

Ireland, Bernard, *Jane's Battleships of the 20th Century*, HarperCollins Publishers (New York, 1996)

Newhart, Max, *American Battleships*, Pictorial Histories Publishing Company (Missoula, Montana, 1995)

Smith, Myron, *Keystone Battlewagon*, Pictorial Histories Publishing Company (Missoula, Montana, 1996)

Terzibaschitsch, Stefan, *Battleships of the U.S. Navy in World War II*, Bonanza Books New York, 1977)

Whitley, M. J., *Battleships of World War Two*, Naval Institute Press (Annapolis, Maryland, 1998)

Wiper, Steve, *USS New Mexico BB-40*, Classic Warship Publishing (Tucson, Arizona, 2003)

www.shipcamouflage.com

Idaho leads *Pennsylvania* and two escort carriers on June 12, 1944, en route to the invasion of Saipan. The USN's older battleships and growing numbers of escort carriers played a key role in amphibious invasions, since they were able to provide massive fire support to the invading troops and were strong enough to deal with any conceivable Japanese naval force that approached the beachhead.

INDEX

References to images and plates are in **bold**.

aircraft 6, 6, 7, 9, 19
 aircraft platform 13, 34
 “all or nothing” protection scheme 13, 14
 antiaircraft protection 9, 10, 11, 11, 12, 12,
 17, 17–18, 18, 19, 23, 24, 26, 32, 34, 35,
 38, 43
 Arizona, USS 22, 25, 28–29
 cranes 23
 propulsion system 23
 sinking of 30, 30, 44
 wartime damage 42
 wartime service 27, 30, 30, 43
 Arkansas, USS 6, 19, 21, 24, 24
 armament
 14-inch guns 4, 6, 9–10, 9, 10, 16, 23, 24,
 32, 32, 42
 16-inch guns 31
 elevation 8–9, 24, 32
 secondary battery 9, 10, 10–11, 10, 16, 17,
 24, 32, 32
 armor 4, 6–7, 8, 9–10, 14, 17, 24, 31, 34,
 34, 42, 43
 Atlantic Fleet 19, 27
 Attu Island, invasion of 19, 26–27, 40, 45

 battleship development 4–5
 Bikini Atoll atomic tests 20, 27, 27
 blisters 8
 broadside 8

California, USS 44
 catapults 9, 17, 22, 24, 26, 35
 Cherbourg, fall of 19, 21
 color schemes 7, 15, 25, 33, 41
Colorado, USS 44
 Colorado class 4
 convoys 19
 costs 4, 6
 cranes 23

 D Day 19
 deck armor 7, 8, 14, 17, 23, 31, 34
Dreadnought, HMS 6
 dreadnoughts 6

 engagement ranges 6–7

 fire control 4, 9, 26, 27, 34, 42
 firepower 7–8, 8–9, 42
 flying-off platforms 17
 fuel 6, 16

 General Board, the 31
 Gilbert Islands, invasion of 27
 Great Britain 4–5
 Guam, invasion of 27
 Guantanamo Bay 16

Idaho, USS 7, 8, 30, 31, 34, 37, 47
 antiaircraft guns 12
 service modifications 34, 35, 36
 wartime service 40, 40
 Imperial Japanese Navy (IJN) 5, 7, 9, 10–11,
 42, 44, 45
 Iowa class 44
 Iwo Jima, invasion of 40, 40

 Japan 4–5

 kamikaze threat 11, 12, 19, 19, 26, 35, 36,
 39, 39, 41, 43

King Board, the 11

 Lexington class battlecruisers 4
 Leyte Gulf, battle of 27
 Lingayen Gulf 36, 41, 46
 London Naval Treaty, 1930 5, 6

 Makin Island, invasion of 38
 Marianas Islands, invasion of 27, 36
Maryland, USS 44, 44
Mississippi, USS 7, 9, 31, 33, 37
 antiaircraft guns 38
 armament 32, 32
 post-war service 39–40
 service modifications 35, 36, 39
 wartime damage 42
 wartime service 38–39

 naval treaties 4–5
 Neutrality Patrol, the 13, 13, 14, 36, 38, 40
Nevada, USS 15
 aircraft 19
 aircraft platform 13
 antiaircraft guns 18, 19
 cagemasts 14
 propulsion system 16
 service modifications 17, 18, 18
 turrets 9, 16
 wartime damage 42, 43
 wartime service 18–20, 19, 43, 44
 Nevada class 4, 15. *see also* individual vessels
 antiaircraft guns 17, 17–18, 18, 19
 armament 6, 10, 16, 17
 armor 6–7, 14, 17
 cagemasts 14, 17
 design and construction 6–7, 7, 13
 international comparisons 42–43
 propulsion system 16
 service modifications 8, 9, 16–18, 17–18, 17
 specifications 16
 speed 9, 16
 turrets 6, 10, 16
 underwater protection 14
 wartime damage 42
 wartime service 18–20, 19, 20, 21, 43, 44, 45
 New Mexico class 4, 7, 10, 33. *see also*
 individual vessels
 antiaircraft guns 12, 32, 34, 35, 38
 armament 32, 32
 armor 31, 34, 34
 cagemasts 34, 34
 deck armor 31
 design and construction 30, 31
 international comparisons 42–43
 propulsion system 31–32, 34
 service modifications 7, 8, 34–36, 34, 35, 39
 specifications 32
 speed 9
 turrets 8, 10
 wartime damage 42
 wartime service 36, 38–40, 38, 39, 40, 41,
 44, 45
New Mexico, USS 7, 31, 31, 33
 antiaircraft guns 12
 armor 34
 propulsion system 31–32
 service modifications 35, 35
 wartime damage 42
 wartime service 36, 38, 38, 39, 41
 New York class 6
New York, USS 6, 19
 Nimitz, Admiral Chester 44
 North Carolina-class 4, 34, 44

North Dakota, USS 17

 Okinawa, invasion of 19–20, 19, 36, 39,
 40, 45
Oklahoma, USS 5, 6, 13, 14, 14, 15, 16, 43
 antiaircraft guns 17–18
 armament 6
 propulsion system 16
 service modifications 17, 17, 18
 wartime damage 42, 43
 wartime service 19, 20, 20, 44

 Pacific Fleet 5, 19–20, 27, 36, 38, 40, 44
 Pearl Harbor, Raid on 18, 18–19, 20, 26, 26,
 30, 36, 43, 43, 44, 44
Pennsylvania, USS 8, 20, 22, 25, 39, 46, 47
 antiaircraft guns 24, 26
 armament 10
 cagemasts 22
 propulsion system 23
 radar systems 13
 service modifications 24, 26
 wartime damage 42, 43
 wartime service 26–27, 26, 27, 44
 Pennsylvania class 4, 25. *see also* individual
 vessels
 antiaircraft guns 23, 24, 26
 armament 10, 10, 22–23
 armor 24, 31
 design and construction 22
 international comparisons 42–43
 propulsion system 23
 service modifications 8, 9, 24, 24, 26
 speed 9, 23, 24
 turrets 10, 22, 22
 underwater protection 23
 wartime damage 42
 wartime service 26–27, 26, 27, 30, 30, 43,
 44, 45
 pre-dreadnoughts 6
 propulsion systems 9, 16, 23, 31–32, 34
 Puget Sound Naval Shipyard 18

 radar systems 4, 12–13, 42
 rangefinders 17, 22
 role 45, 47
 Royal Navy (RN) 5, 7, 9, 11, 13, 42

South Carolina, USS 6
 South Dakota class 4, 9, 44
 speed 9, 16, 17, 23, 24, 34, 42, 44
 superdreadnoughts 4, 6, 13
 Surigao Strait, battle of 38–39, 42–43

 tactics 5
 Task Force 1 44
Tennessee, USS 44, 44
 Tennessee class 4
Texas, USS 6, 19, 21
 torpedoes 6, 10–11, 16, 23, 32, 43
 turboelectric drive 31–32
 turrets 6, 6, 7–8, 8, 9, 10, 16, 22

 underwater protection 8, 14, 23
 United States Navy (USN), battleship fleet 4
Utah, USS 6

 War Plan Orange 5
 wartime damage 42, 43
 Washington Naval Treaty, 1922 5, 8, 9
West Virginia, USS 43, 44
 World War I 4
Wyoming, USS 6

First published in Great Britain in 2015 by Osprey Publishing,
PO Box 883, Oxford, OX1 9PL, UK
PO Box 3985, New York, NY 10185-3985, USA
E-mail: info@ospreypublishing.com

Osprey Publishing is part of the Osprey Group

© 2015 Osprey Publishing Ltd.

All rights reserved. Apart from any fair dealing for the purpose of private study, research, criticism or review, as permitted under the Copyright, Designs and Patents Act, 1988, no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, electrical, chemical, mechanical, optical, photocopying, recording or otherwise, without the prior written permission of the copyright owner. Inquiries should be addressed to the Publishers.

© Osprey Publishing. Access to this book is not digitally restricted. In return, we ask you that you use it for personal, non-commercial purposes only. Please don't upload this ebook to a peer-to-peer site, email it to everyone you know, or resell it. Osprey Publishing reserves all rights to its digital content and no part of these products may be copied, stored in a retrieval system or transmitted in any form by any means, electronic, mechanical, recording or otherwise (except as permitted here), without the written permission of the publisher. Please support our continuing book publishing programme by using this e-book responsibly.

Every effort has been made by the Publisher to secure permissions to use the images in this publication. If there has been any oversight we would be happy to rectify the situation and written submission should be made to Osprey Publishing. A CIP catalog record for this book is available from the British Library

Print ISBN: 978 1 4728 0696 3

PDF ebook ISBN: 978 1 4728 0697 0

ePub ebook ISBN: 978 1 4728 0698 7

Index by Alan Rutter

Typeset in Sabon and Myriad Pro

Originated by PDQ Media, Bungay, UK

www.ospreypublishing.com

ACKNOWLEDGMENTS

The author would like to thank Real War Photos for their assistance in procuring the photos for this book.